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AMERICAN MACHINIST

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Steam Traction on Highways in England.

Quite an important trial of steam vehicles for heavy traction on common roads was recently held at and near Liverpool, England, under the auspices of the Liverpool Self-Propelled Traffic Association, who offered substantial prizes to the competitors. The chief object of the trials was to arrive at a type of heavy motor wagon, which should be capable of economically taking the place of horse haulage. The competition turned out to be one of steam-driven vehicles only, but there was no restriction as to the source of power, so that it was mechanical and self-contained in the vehicle carrying the load. The part carrying the generator or motor might be detachable from the part carrying the load, but the vehicle should be capable of going anywhere that a horse-drawn vehicle carrying the same load could go, and of being placed in the same position and of being withdrawn therefrom without external assistance.

The length of road to be traversed was a circuit of thirty-five miles with grades of considerable length, but not exceeding in steepness 1 in 24. But four vehicles appeared in the trial, and not one of these was from the best known builders, such as Aveling & Porter or Fowler & Co. The most defective feature developed in the runs was apparently in the tires of the traction wheels, three of the four vehicles being delayed for repairs to wheels on the first day. The trial was not a race, although a time schedule was, if possible, to be fulfilled. The vehicles carrying 2 tons were to make six miles an hour and those carrying 5 tons four miles an hour. A 2-ton vehicle fired with liquid fuel made the run in the net time of 4 hours 56 minutes, burning 20 gallons of oil and experiencing no serious incident except hot boxes. A wagon with a load of 2½ tons made the run in the net time of 6 hours and 33 minutes, but was delayed four hours on the way by the giving out of a boiler tube. One 5-ton vehicle got in so late that the time was not given, while a 4-ton van did not complete the run. On the second day the 5-ton vehicle did not run, while the other three each completed the trip, one of them knocking out the entire end of its low pressure cylinder on the way. Trials occurred also with various incidents on the three following days. In the maneuvering trials all the vehicles performed well. The weights of the vehicles seemed to be about equal to that of the loads carried. The results as a whole are said to have been encouraging for the future of steam propelled vehicles.

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Making an Accurate Index Plate.

BY G. P. WETMORE.

Having occasion some time since to graduate or divide some plates for automatic machines, and finding the milling machine dividing head too far out of true I determined to originate plates for our special purpose.

While the plan adopted may not be new it certainly was original as far as I was concerned, and may be of some interest to the readers of the "American Machinist."

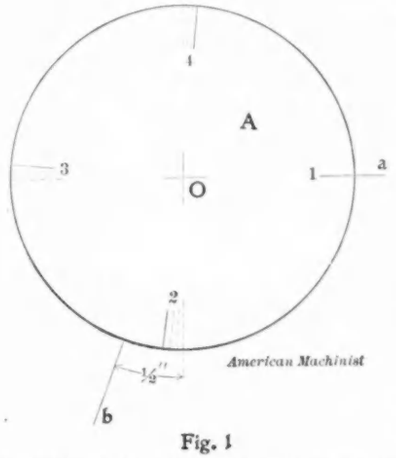

Fig. 1

DIAGRAM ILLUSTRATING PRINCIPLE OF INDEXING.

The manner in which it was done may, I think, be understood by the accompanying sketches.

Referring to Fig. 1, first to illustrate merely the principle involved, *A* is a disk, free to revolve on a fixed centre *o*, it is not necessary that we should know the circumference of this disk, but for convenience let it be exactly 8 inches. It is proposed to divide this disk into four equal divisions by drawing radial lines at the outer edge. The distance from one line to the next, measured on the circumference, must, therefore, be 2 inches. At two points outside of the disk and somewhat more than 90° apart we locate the stationary lines *a* and *b*. Again it is not necessary that these lines should be any definite distance apart, or that we should know the distance, but for convenience in describing let them be 2½ inches apart measured on the curve of the circumference. Line *b* is therefore ½ inch more than 90° from line *a*. Draw line 1 and let it coincide with line *a*. We could now locate line 2 by measuring out ½ inch from line *b*. This would make the distance from line 1 to line 2 2 inches, or 90°, and would, of course, be correct, but we are not supposed to know this. How are we, therefore, to know what distance we should measure out from line *b* in order to locate line 2 exactly one-fourth part of the circumference from line 1?

This may be found as follows: We have already drawn line 1; now draw the other lines, 2, 3 and 4 as near correct as we can by spacing off with dividers. Of course we do not get the distances exact, and will suppose we get the spaces from 1 to 2 2⅛ inches, from 2 to 3 2 1-16 inches, from 3 to 4 1 15-16 inches, and from 4 to 1 1⅞ inches. We now turn the disk so that 1 coincides with *a* and measure from *b* to 2 and find it is ⅜ inch. Turn the disk to bring 2 in line with *a* and measure from *b* to 3 = 7-16 inch; turn 3 opposite *a* and measure = 9-16 inch; turn 4 opposite *a* and measure = ⅝ inch; add these four measurements, ⅜ + 7-16 + 9-16 + ⅝ = 2 inches; divide this by 4 (4 spaces): 2 ÷ 4 = ½ inch, which is the distance to measure out from *b* to locate 2 in its right position. We have therefore found this measurement without knowing the circumference of the disk, or the exact location of the lines *a* and *b*. This process of reasoning holds good for any number of spaces. After drawing corrected line 2 turn 2 opposite *a* and draw corrected line 3, turn 3 opposite *a* and draw corrected line 4. The lines should now all be an equal distance apart, but as we have probably made our measurements in straight lines, (it being more convenient to do so), not in curved lines, which are required, a small error will probably have crept in, so that the disk will not be exactly di-

vided. To make the spaces exact it is only necessary to go through the operation just described once or twice more, each time using the corrected lines to measure from. It will be readily understood that as the spacing approaches perfection the difference between a straight line and a curved line becomes less and less until perfection is reached, when the difference vanishes altogether.

Having explained the principles used we will proceed to show how we used them. Referring to Fig. 2 *A* is a cast iron block adapted to be bolted to a miller table, *B* is a hardened and ground steel spindle, which can be revolved in *A*, but not having any shake. *C* is the cast iron index plate which it is desired to divide into 8 spaces. This plate is driven on to spindle *B*. *D* is a sector nicely fitted to the spindle, so that it can be revolved without turning the spindle and plate. On this secter and at a distance apart of approximately 45° are fastened two blocks, *E* and *F*, having lock pins *G* and *H* passing through them. These blocks are so placed that one side of each lock pin is radial from the center of the plate *C*. *I* is a micrometer with a large barrel graduated to tenths of thousandths. The end of the micrometer screw abuts against the sector for making the measurements. *J* is a clamp which can be fastened to the plate by the screws shown. The screws *K* and *L*, having fine threads, are adapted to move the clamp *J*, and consequently turn the plate a small distance in either direction, and hold the plate firmly when so turned. *M* is the miller arbor with a mill in place, one side of the mill being placed radial with the center of the plate. The notches in the plate are first cut somewhat narrower than finished size. The spacing may be done with dividers or by any indexing arrangement which will be true enough to start with.

To use the jig, notch 1 is set so that a light cut may be taken by the mill on one side of the notch, the sector being turned around out of the way of the mill. After taking this cut the sector is brought back into position, and latch *G* pushed in and a measurement made with the micrometer. This is an important measurement, and will be referred to as "measurement 1." Lock pin *G* is then pulled out and lock pin *H* pushed in and a measurement made. The plate is then revolved one space, and by using latch pin *G* and "measurement 1" the notch 2 is brought to exactly the same position as that occupied by notch 1, and consequently exactly in line with the mill. Latch *G* is then pulled out, latch *H* pushed in and another measurement made, the idea being to use latch *G* and "measurement 1" to bring the successive notches into the same position, and to use latch *H* to measure the spaces. Add the successive measurements made with latch *H*; divide this by the number of notches and we have another important measurement, which we will call "measurement 2." By using latch *H* and "measurement 2" the notch opposite the mill may now be cut in its correct position. Bring the last notch to bear on latch *H*, set and cut another notch, and so on all the way around. It will usually be necessary to go through this operation several times to get rid of all the errors. After one side of the notches are cut it is an easy matter to set the mill and cut the other side of the notches.

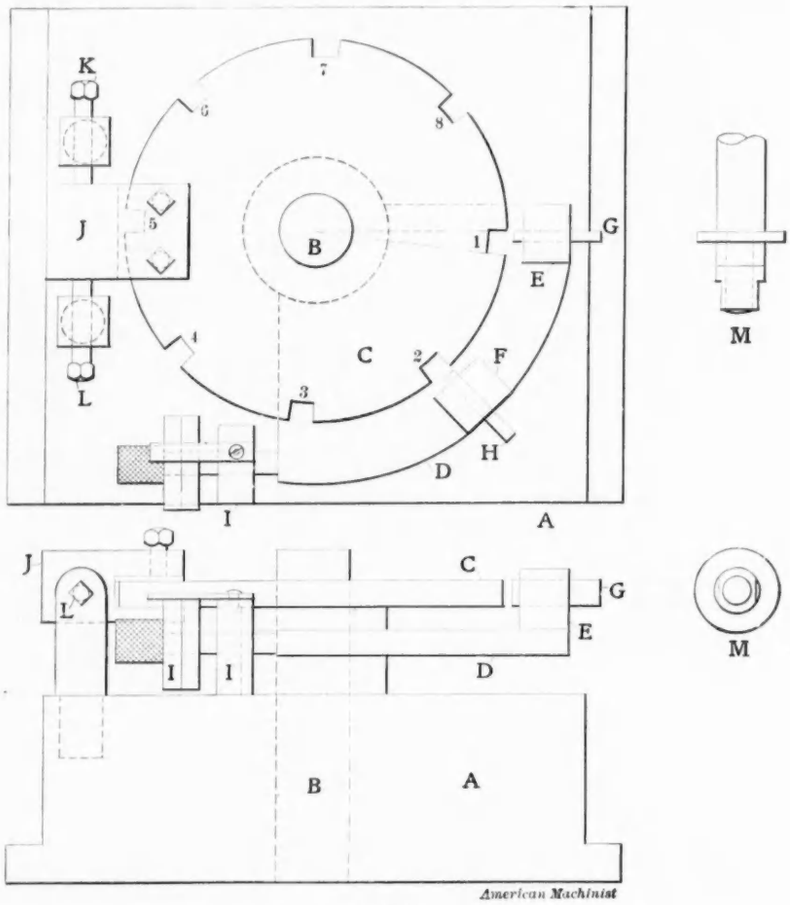

Fig. 2

FIXTURE USED FOR INDEXING AND MILLING NOTCHES.

While it takes a good many words to describe this process the process itself is very simple. The measurements may be accurately made and the jig is inexpensive. Not the least in importance are the knowledge of just how near perfect the plate is and the facility of continuing the perfecting process to the required degree.

We have cut plates with 8, 10, 12 and 18 spaces. The last space of a plate having 18 spaces was 1-10,000 large. Each of the other spaces must therefore have been 1-18 of 1-10,000 = 1-180,000 small. As the plates were 12 inches in diameter the largest error, 1-10,000, was equal to 1-1050 of a degree. A pretty small error for ordinary machine shop work, especially when it is remembered that the plate was cut around only three times, taking the time of one man for three-quarters of a day. This being accurate enough for our purpose we did not try to go further, but certainly could if the conditions warranted.

Waterbury, Conn.

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The Truth and Errors of Mr. Wiener's Method of Finding the Area of Curvilinear Figures.

BY PROF. J. J. GUEST.

As the elegance and simplicity of Mr. Wiener's construction will recommend it to engineers, a simple but rigorous proof of its truth may prove acceptable to those who cannot follow the thread of Mr. Wiener's arguments or realize the value of Professor Church's criticisms on the approximations involved.

[As a proof demanding a previous knowledge of a little geometry only will appeal to a wider circle of engineers than can have digested the previous articles, Mr. Wiener will, I hope, pardon me if, in furnishing the following proof, I redescribe his method of proceeding, taking only a slightly different point of view.]

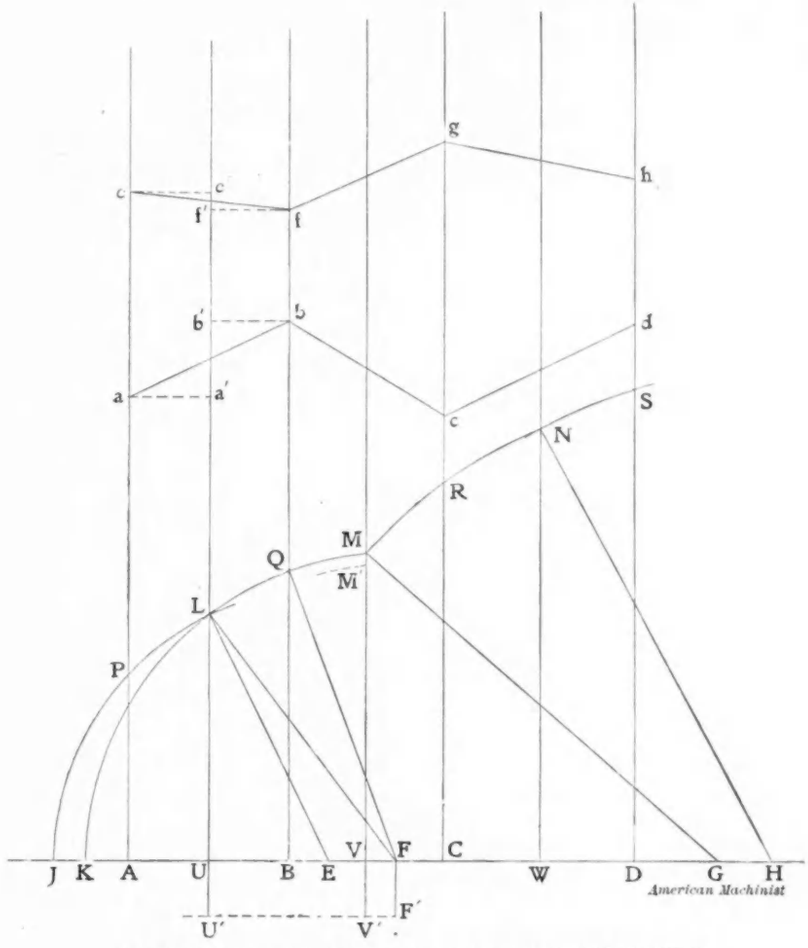
Let it be required to find the area of

the rectilinear figure *a b c d h g f e*, in which *a e*, *b f*, *c g*, and *d h* are parallel.

Method.—Produce the lines *e a*, *f b*, *g c*, *h d* and draw a line perpendicularly across them, meeting them in *A B C* and *D*. This line should, in practice, be drawn close to the figure whose area is required, so as to minimize errors due to drawing; in the figure it is placed well away for the sake of clearness.

On *A a* choose any point *P*. Make *A E* = *a e* and with center *E* and radius *E P* describe the circle *J P L*, meeting *A B C* in *J* and the line *U L* midway between *A a* and *B b* in *L*.

Make *B F* = *b f*, and with center *F* and radius *F L* describe the circle *K L Q M*,



GRAPHICAL DEMONSTRATION OF MR. WIENER'S METHOD.

cutting *A B* in *K*, *B b* in *Q* and the line *U M*, midway between *B b* and *C c*, in *M*.

Continue in this manner until the last ordinate *D d* is cut by the circle whose center is *H* and radius *H N* in *S*.

Then $S D^2 - P A^2$ is accurately equal to the rectilinearly bounded area *a b c d h g f e*.

Proof.—Draw *a a*^{1}, *b b*^{1}, *f f*^{1}, *e e*^{1} perpendiculars to *U L* (produced). Then area *a b f e* is evidently equal to area *a a*^{1} *e*^{1} *e* + area *b b*^{1}, *f*^{1} *f*.

Therefore, area

$$a b f e = A U \times a e + B U \times b f$$
$$= A U \times A E + B U \times B F. \quad (A)$$

Now, $Q B^2 = Q F^2 - B F^2$
$= K F^2 - B F^2$
$= (K F - B F)(K F + B F)$
$= K B . (2 K F - K B)$

which equation could have been written down at once by Euclid III., 35.

Again, $L U^2 = L F^2 - U F^2$
$= K F^2 - U F^2$
$= (K F + U F)(K F - U F)$
$= K U (2 K F - K U)$

Therefore $Q B^2 - L U^2$
$= 2 K F (K B - K U) - (K B^2 - K U^2)$
$= 2 K F . B U - (K B + K U) B U$
$= B U \{ 2 K F - 2 K B + K B - K U \}$
$= B U \times 2 B F + B U^2 \quad (1)$

Similarly $L U^2 - P A^2$
$= A U \times 2 . U E + A U^2$
$= A U \times 2 A E - A U^2 \quad (2)$

Therefore adding (1) and (2)

$$Q B^2 - P A^2 =$$
$$2(B U \times B F + A U \times A E) + B U^2 - A U^2$$

Since $B U = A U$, this reduces to (3)

$$Q B^2 - P A^2 = 2(B U \times B F + A U \times A E)$$

which from equation (A) above

$$2 \text{ area } a b f e$$

In the same way

$$R C^2 - Q B^2 = 2 \text{ area } b c g f$$
$$S D^2 - R C^2 = 2 \text{ area } c d h g$$

Therefore adding

$$S D^2 - P A^2 = 2 \text{ area } a b c d h g f e$$

The method evidently applies whatever be the number of ordinates or whatever the distances between them. It is to be noted that the construction does not fail when the value of *P A* chosen is zero, and this, as Mr. Wiener points out, is the best value to select, as it minimizes the errors.

The method therefore gives mathematically a perfectly accurate result for any such rectilinearly bounded area, the only practical errors being those of draftsmanship.

The construction will fail in case the circle whose center is *E* does not cut the line *U V*; that, however, is easily remedied by selecting a larger value of *P A*, or an ordinate closer than *B b*.

In finding the area of a curvilinear figure by this method, the first operation, after drawing suitable ordinates (*a e*, *b f*) is to "equalize the boundary," *i. e.*, to draw a rectilinear figure approximating to the curvilinear and as nearly as possible equal to it in area. (See any book on civil engineering.) In case this is not done the ordinates should be selected so that the polygon through the points where they cut the curve is roughly equal to the curvilinear area.

The other sources of error lie in the draftsmanship, and the principal of these are outlined below, so that the errors are:

(1) Errors caused by equalizing (or not) the boundary.

(2) If an error of amount *x* is made in transferring *a e* to *A E*, the error produced in the result is

$$= a a^1 \times x$$
$$= \tfrac{1}{2} . A B . x$$

The same error is made if, in drawing the circle *J P L*, the compass needle is placed on the line *A B E*, but an amount *x* off the point *E*. If, however, these errors are made at one of the interior centers, say *F*, the error counts twice over and is $\frac{1}{2} (A B + B C) x$.

(3) If the line *L U*, drawn through the intersection of circles *J P L*, *L Q M* is not midway between *A P* and *B Q*, but is out of position by an amount *y*, the error produced in the result is, from equation (3),

$$\tfrac{1}{2} (B U^2 - A U^2) = \tfrac{1}{2} (B U + A U)$$
$$(B U - A U) = \tfrac{1}{2} . A B . y .$$

(4) If the center of a circle, say *F*, is taken off the line *A B C* by an amount *z*, the error is $z (M V + L U)$ to the first order. For suppose F^1 to be taken as a center instead of *F*, and F^1 to be at a distance *z* below *F*, and $M^1 U^1 V^1$ the consequently erroneous positions of *M U* and *V*.

Then by equation (3) $M^1 V^{12} - L U^{12}$
= area of initial figure between *U L* and *V M*
$= M V^2 - L U^2$

$\therefore$ The error

$= \frac{1}{2}(MV^2 - M'V')$

$= \frac{1}{2}\{MV^2 - (M'V' - z)^2\}$

$+ 2.MV.z$ neglecting z^2

$= \frac{1}{2}\{2.LU.z + 2MVz$ neglecting z^2

$= (LU + MV)z.$

The errors being small their squares can be neglected, and so to find the error which could be produced we consider them all of the same sign and add them together.

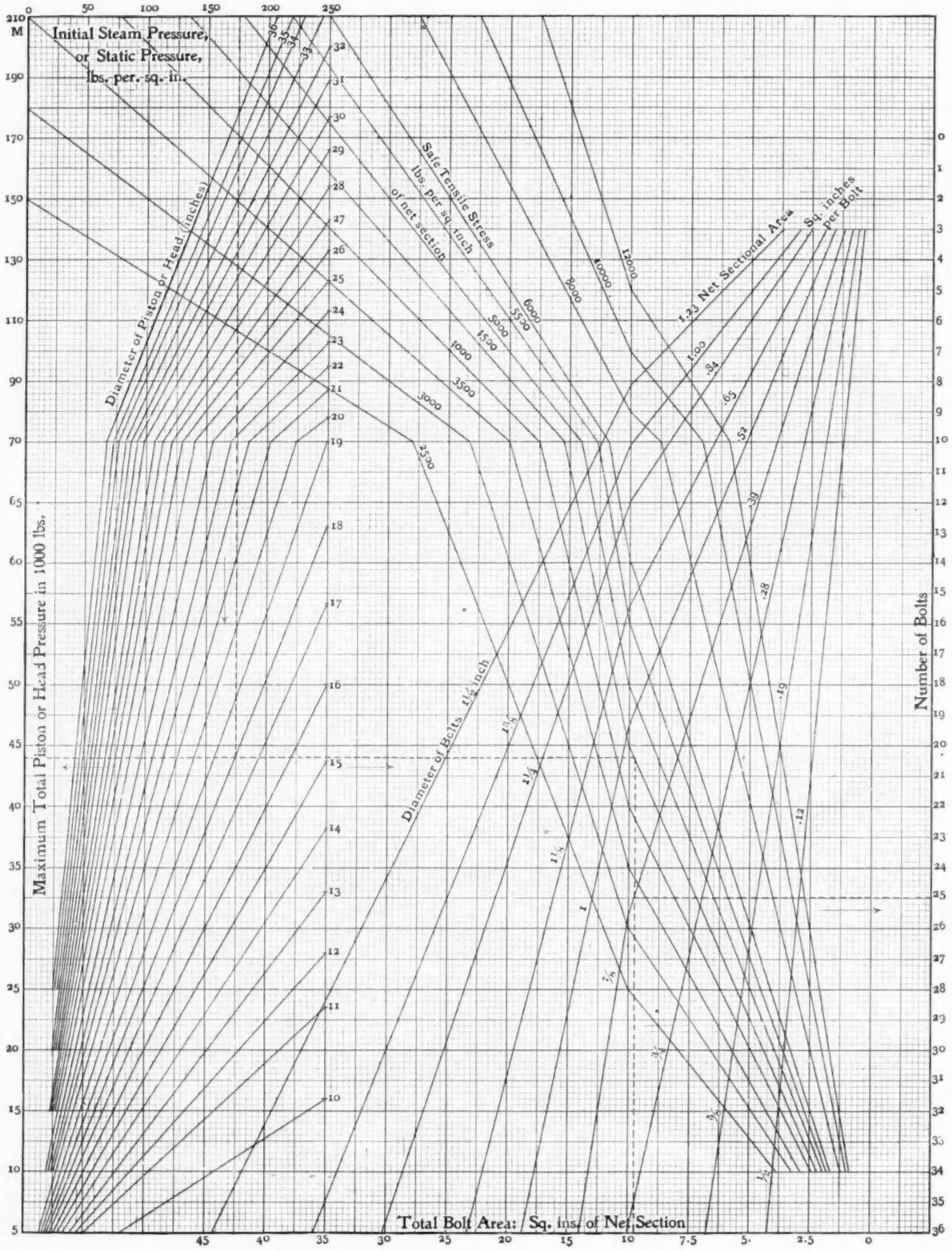

Initial Steam Pressure, or Static Pressure, lbs. per sq. in.
Diameter of Piston or Head (inches)
Safe Tensile Stress lbs. per sq. inch of net section
Maximum Total Piston or Head Pressure in 1000 lbs.
Diameter of Bolts, 1/4 inch
1.33 Net Sectional Area
Sq. inches Per Bolt
Number of Bolts
Total Bolt Area: Sq. ins. of Net Section

CHART FOR CYLINDER OR TANK HEAD BOLTS.

$= \frac{1}{2}\{MV^2 - M'V'^2 + 2M'V'.z - z^2\}$

$= \frac{1}{2}\{MV^2 - MV'^2 + LU^2 - LU'$
$+ 2M'V'.z$ neglecting z^2

$= \frac{1}{2}\{LU^2 - (LU - z)^2$

It must be noticed—an important point—that an error produces its effect on the final result at once and is not increased by the subsequent operations.

The amount of the errors can be easily calculated by any interested draftsman, who can select his own values for x, y,

etc., and thus obtain greater satisfaction.

MECHANICAL DEPARTMENT,
Worcester Polytechnic Institute.

[We have also received a demonstration, which is similar in principle to the above, from Mr. C. Garrett Smith, of Krailling-Planegg, Bavaria. Of Mr. Wiener's method Mr. Smith says: "I think it the best thing I have seen for a long time."—ED.]

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Cylinder and Tank Head Bolts.

BY F. K. CASWELL.

Determining the number and diameter of bolts or studs required to safely secure a cylinder or tank head against a given pressure is a simple problem, but being somewhat tedious, is often decided by rule of thumb or so-called judgment. It is very easy to say "our old 18-inch cylinder engines had thirteen 7/8 inch bolts, and as these new ones are only 1 inch larger cylinder, two more ought to hold all right," losing sight of the difference in load, due to increased steam pressure, and sometimes forgetting that with the same pressure per square inch the total bolt area should increase in direct proportion with the cylinder area.

The accompanying chart was designed to simplify this problem and solve it so rapidly that the old excuse "no time" cannot longer be given. To illustrate the use of the chart let it be required to find the number and diameter of bolts for the cylinder head of a locomotive, the bore of the cylinder being 18 inches and the steam pressure 175 pounds per square inch. Find 175 on the pressure scale at the top of the chart, and follow this line downward until it intersects the cylinder diagonal marked 18; then follow horizontally across the chart to the stress diagonal, in this case 4,500 pounds per square inch, where the bolt area (9.75 inches) can be read at the bottom of the chart; or following the vertical line at this intersection downward to the 7/8 inch diagonal and then horizontally to the number of bolts' scale at the right the number of bolts (25) can be read.

By following the pressure per square inch (175) vertically to its intersection with the cylinder diameter diagonal (18) and thence horizontally to the left hand scale, the total pressure or load on the head can be read in thousand pounds (44,000.)

This chart can also be used for all other bolted heads, substituting the static pressure per square inch for the initial steam pressure.

[Regarding the strains to be used, Seaton advises 4,000 pounds on the net section, or 3,500 pounds if the studs are less than 7/8 inch. In some recent locomotive drawings which we examined lately, the studs being of iron, this strain ran up to 8,100 pounds. The question of tightness of joint must be looked to as well as strength of bolt. For 100 pounds steam pressure and gasket joints the distance between bolt centers should not exceed about 5 inches, and for 200 pounds pressure 3 inches. With small cylinders, using customary sizes of studs, provision for tightness gives an excess of strength, and with ground joints we expect this is true for cylinders of considerable size. It is largely this consideration of tightness which decides the diameter of studs to be used—large studs giving an increased pitch and vice versa.—ED]

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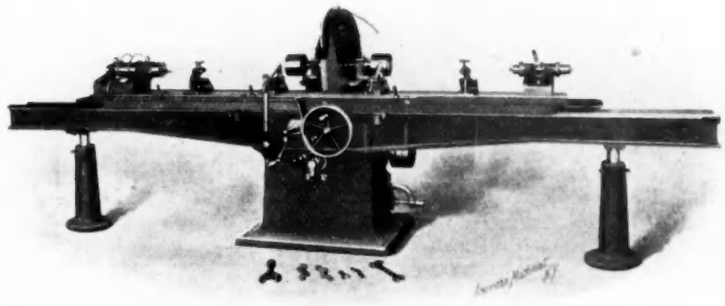
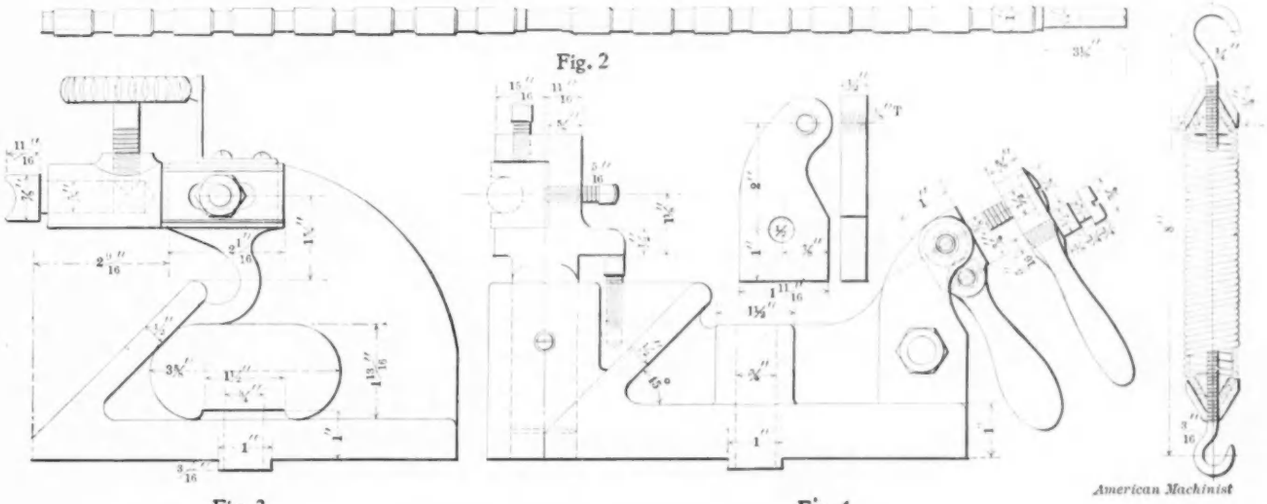
A Grinding Machine for Special Work.

The machine shown in the accompanying engraving will, we fear, impart a serious shock to those who stoutly maintain that every machine tool of moderate size at least should be so designed that its bed will maintain its form independently of the floor upon which it stands. It is of course clear that this machine will do nothing of the kind, and yet for the purpose for which it was designed we are assured that it is an entire success. It is simply an extension of a previously designed machine to fit it for a special class of grinding which does not require the extreme accuracy aimed at in some other classes of work and is not heavy in proportion to its length. The machine is, of course, designed to stand upon a masonry foundation.



GRINDING MACHINE FOR LONG SPINDLES.

The machine is used for grinding the



BACK RESTS FOR LONG GRINDING MACHINE.

fluted rolls in spinning, twister and speeder frames in cotton mills. These rolls, Fig. 2, are made in sections which vary from 22 to 28 inches in length and when put together are from 10 to 35 feet long. The sections are joined by a square tapered end on one, fitting a broached hole in the other. The completed roll runs in semicircular bearings, in which the necks of the sections rest, so, to secure concentricity, it is necessary to run the sections in similar bearings when being ground. The machine must be long enough to take at least two sections. The first and second are ground together, then the second and third, and so on. The machine carries a wheel 26x1½ inches and a pump gives a copious flow of water. The wheel is driven by two belts. It is designed to remove a large amount of stock in a given time and yet do work sufficiently accurate, the usual limit being .001 inch over or under the nominal size.

The levers in front of the machine stop and reverse the feed at any point, so that any high parts may be ground without traversing other parts which require less grinding. The belt driving the work may be shifted from any part of the machine by means of the long horizontal rod. The hand wheel by which the emery wheel is fed up to the work is graduated to read to thousandths of an inch. Figs. 3 and 4 show the back rests used for steadying the roll, that in Fig. 4 being used near the grinding wheel and 3 nearer the ends. In Fig. 4, a short hand lever with a stud at the side is noticed. A spiral pull spring shown at the right hooks upon this stud, a large hook upon the other end of the spring hooking over the roll, and when the lever is thrown down as shown there is sufficient tension on the spring to hold the roll securely against the bearings.

The machine is built by the Diamond Machine Company, Providence, R. I.

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Some Tools Used in Lathe Building.

BY W. L. SHELLENBACK.

The accompanying sketches show some devices used upon the lower slide of a compound rest. Fig. 1 shows in use a planer chuck which is applicable to many other jobs as well as this. *A* is the planer platen, and into one of the tee slots is tongued and bolted the cast iron bar *B*, which may be made in sections of 3 or 4 feet in length, and extend the entire length of the platen. *C* is the compound rest slide. On its under side are pads *E E*, which are cast to it, and faced flush with the surface upon which the swivel is mounted. These lugs are cast on for convenience in planing and drilling, and after that they are removed. There is a groove planed in the side of the bar *B*, into which are fitted taper steel strips *D*, which are each the exact length of one piece *C*. The top, sides and ends of the work are first planed in the ordinary manner. The work is then clamped as shown, and the gib side is planed and tongued to receive the gib, which is shown in dotted lines. These gibs are made a driving fit, and are driven "home" with the thick end extending out past the front end of the slide to allow for take-up in scraping them to a bearing and adjustment for wear. The taper strips *D* are now removed, and the work is clamped against the bar *B*, and the dovetailed planed and finished to a gage, the dotted lines showing the finish line of work. Fig. 2 shows the gib used. It contains two clamping lugs *A A*, and a number of these gibs may be strung the entire length of the platen and held with the chuck shown in Fig. 1. The tongue side of the gib is finished to a gage, and the beveled side is left rough to be finished with the slide, as previously mentioned. The clamping lugs are then broken off and the notch is milled at both ends for the adjusting screw *B*.

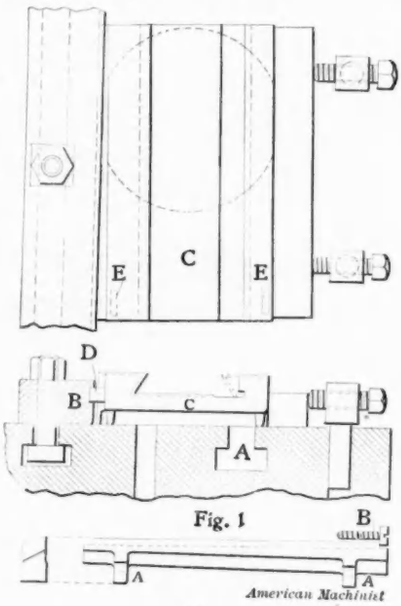


Fig. 1

Fig. 2

CHUCKING FOR TAPER PLANING

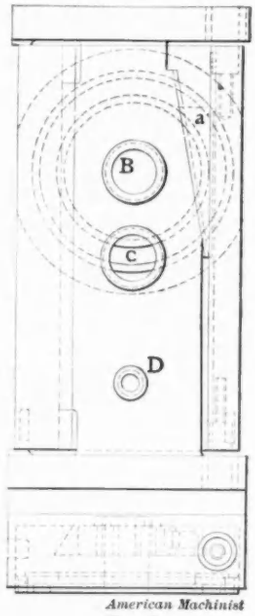


Fig. 3

JIG FOR DRILLING COMPOUND REST SLIDE.

Fig. 3 represents a drilling jig. It is planed to fit against the solid dovetail side of slide, and on the other side is

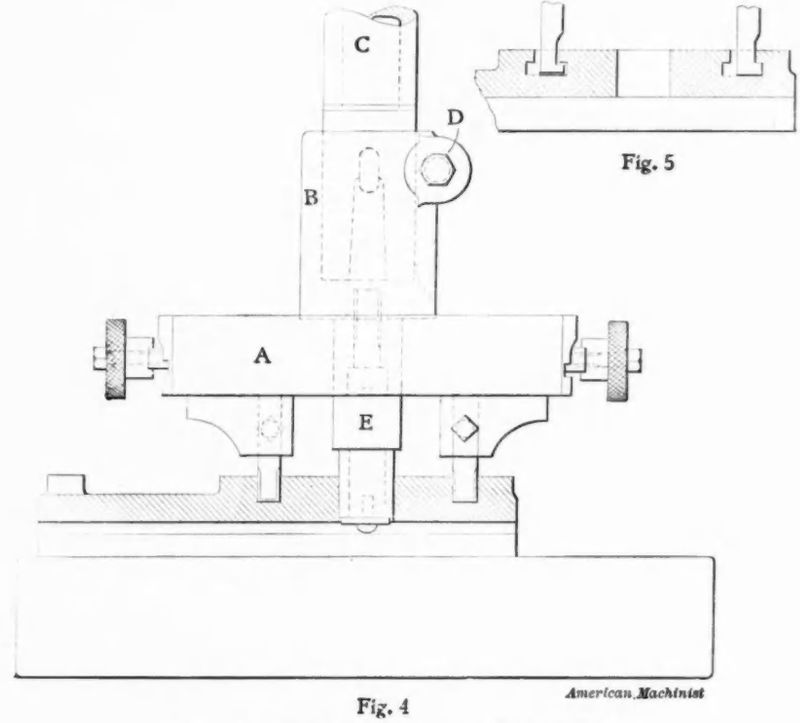


Fig. 4

TURNING OUT T SLOTS WITH UPRIGHT DRILL.

Fig. 5

wedge *A*, which holds it firmly in its place. This wedge is grooved and fitted to a tongue on jig, on one side, and on the other it is provided with a tongue which hooks under groove in work, thereby holding it in place. The small pads at each end, on the left-hand side,

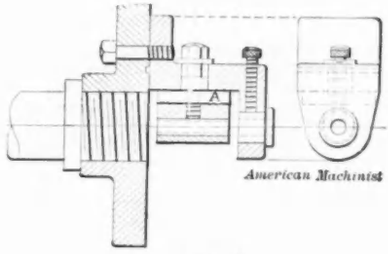
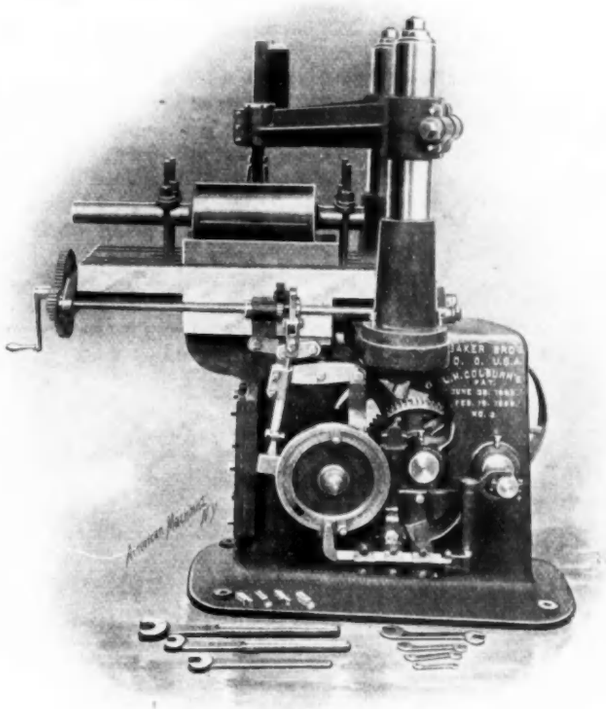


Fig. 6

CHUCK FOR FEED NUT.

prevent any end motion. The jig is so arranged that it may be stood on either end as well as on either side. The gib screw holes at the ends are drilled, counterbored and tapped; also the center hole at *B* and the hole for the nut screw at *D* are drilled. Hole *C* is an opening through which the swing bolts are passed, and this is not drilled until after the swing-bolt slots are turned.

Fig. 4 is a drill press cutter head for turning annular tee slots. It consists of an ordinary box-chuck *A* fitted to a split sleeve *B*, which is clamped to the drill press spindle *C* by means of screw *D*. Pilot *E* is fitted into the center hole of the chuck, and on its lower end is a hardened sleeve, which remains stationary in the work as the head revolves, thereby avoiding wear in the hole. Square holes are cut into the jaws of chuck *A*, and suitable tools are slipped in and held in position by set screws. The cutting edges of these tools may be set the required



AN IMPROVED SLOTTING MACHINE.

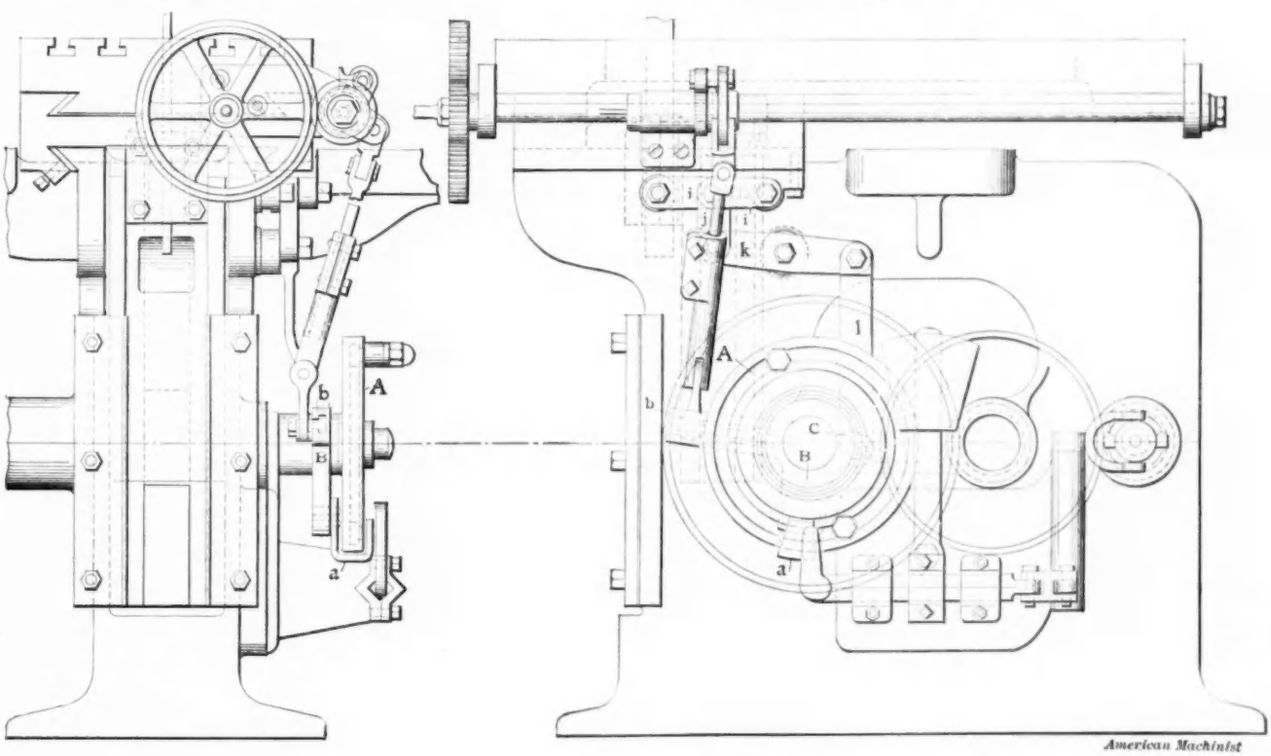


Fig. 2

DETAILS OF SLOTTING MACHINE.

distance from the shoulders on the pilot *E*, thus serving as a dead-stop to determine the depth of the slots. The tools are adjusted in or out by means of knurled knobs on the ends of the screws. A wire filed the required length may be held between the cutting tool and the pilot to serve as a gage for setting the tools. Fig. 5 shows the right and left L tools working on both sides of a circular slot simultaneously. Of course the head revolves slowly, giving ample time for feeding by hand. The radial adjustment of the jaws and the provision made for the use of sleeves differing in size makes this device applicable to quite a wide range of work.

Fig. 6 is an angle plate chucking device, preferably applied to a turret lathe face-plate, and is used for drilling and tapping the cross-feed screw nuts. The seats of these nuts are first planed or milled, after which they are drilled and tapped for the cap screw hole. They are then clamped to the angle plate by the cap screw shown. Washer *A* has a projecting hub, which fits into angle-plate, and is bored to receive the cap screw. The thickness of these washers may be varied for the different sizes of nuts at hand. It will be seen that the angle plate is extended down in front of the work, and this extension is bored true to receive hardened bushings, which prevent the drills and taps from going astray.

▲ ▲ ▲

An Improved Slotting Machine.

The machine here illustrated is perhaps more fully entitled to the name of slotting machine and is more frequently employed in actually working out slots than the machine to which the designation is usually applied. This machine is really a modification of, and an improvement upon, the well-known Colburn keyseater, with which our readers are familiar. It is powerful enough to work a tool with 2 inch face in cast iron or 1½ inches in steel, with 15 inch stroke and a length of stroke are carried, not by the slide, but upon the face of a T slotted disk on the outer end of the piston shaft. In the regular keyseater the table is usually fed by hand, but on this machine an automatic feed has been provided, and also a clearance or withdrawal movement of the work upon the ascending stroke of the tool. Upon the pinion shaft and behind the slotted disk *A*, Fig. 2, is a rocking arm *B* with three projections. The lower *a* of these projections extends out under the slotted disk and up in front of it, and when struck by one or the other of the shipping studs or dogs on the face of the disk the rocking arm *B* is moved simultaneously with the shipper. The longest projection *b* of this

STRENGTH OF GEAR TEETH: CYCLOID AND 15 D

FORMULA: $k = \frac{W}{s}$ per s

k = constants of table. W = working load, pounds. s = maximum fibre stress, pounds per s

y = Lewis' variable for num

No. of Teeth	c =	0".393			0".524			0".628			0".785			0".898			1"			1".25			1".5		
	p =	8			6			5			4			3.5			3.142			2.513			2.094		
	f =	2	2.5	3	2	2.5	3	2	2.5	3	2	2.5	3	2	2.5	3	2	2.5	3	2	2.5	3	2	2.5	3
12		.021	.026	.031	.035	.046	.055	.053	.066	.079	.083	.103	.124	.108	.135	.162	.134	.168	.201	.209	.262	.314	.302	.378	.452
13		.022	.027	.033	.037	.048	.058	.055	.069	.083	.086	.108	.129	.113	.141	.169	.140	.175	.210	.218	.273	.328	.315	.395	.472
14		.022	.028	.033	.039	.049	.059	.057	.071	.086	.089	.111	.133	.116	.145	.174	.144	.180	.216	.225	.282	.337	.324	.407	.486
15		.023	.029	.035	.041	.050	.062	.059	.074	.089	.092	.116	.139	.121	.151	.182	.150	.188	.225	.235	.293	.352	.338	.423	.506
16		.024	.030	.036	.042	.053	.063	.061	.076	.091	.095	.118	.142	.124	.155	.186	.154	.193	.231	.241	.301	.360	.346	.434	.519
17		.025	.031	.037	.044	.055	.066	.063	.079	.095	.098	.123	.148	.130	.161	.193	.160	.200	.240	.250	.313	.375	.360	.451	.540
18		.025	.032	.038	.046	.057	.068	.065	.082	.098	.102	.128	.153	.134	.167	.200	.166	.207	.249	.259	.324	.389	.374	.469	.560
19		.027	.034	.040	.048	.060	.072	.069	.085	.107	.107	.134	.160	.140	.175	.210	.174	.217	.262	.272	.339	.408	.392	.491	.587
20		.028	.035	.042	.049	.062	.075	.070	.089	.108	.111	.139	.165	.146	.182	.217	.180	.225	.270	.282	.352	.421	.405	.508	.606
21		.028	.036	.043	.050	.063	.076	.073	.091	.109	.113	.142	.169	.148	.185	.223	.184	.230	.277	.288	.359	.432	.415	.521	.623
23		.029	.036	.044	.051	.064	.078	.074	.093	.111	.116	.145	.174	.151	.189	.228	.188	.235	.282	.294	.367	.440	.423	.532	.634
25		.030	.038	.045	.053	.067	.080	.076	.096	.114	.119	.149	.179	.156	.195	.235	.194	.243	.292	.303	.380	.454	.437	.550	.654
27		.031	.039	.046	.055	.069	.083	.079	.099	.118	.123	.154	.185	.161	.201	.242	.200	.250	.300	.313	.390	.469	.450	.566	.675
30		.032	.040	.047	.056	.070	.084	.080	.101	.121	.126	.157	.188	.164	.205	.246	.204	.255	.306	.319	.397	.478	.459	.578	.688
34		.032	.040	.048	.057	.071	.086	.082	.103	.123	.129	.161	.193	.168	.209	.252	.208	.261	.312	.326	.407	.488	.468	.593	.703
38		.033	.041	.050	.059	.073	.088	.084	.104	.127	.132	.165	.197	.171	.216	.258	.214	.267	.321	.333	.417	.500	.482	.606	.723
43		.034	.043	.051	.061	.075	.091	.087	.108	.130	.135	.169	.203	.177	.222	.266	.220	.275	.331	.343	.429	.515	.495	.624	.743
50		.035	.043	.052	.062	.077	.092	.089	.110	.133	.138	.172	.206	.181	.225	.272	.224	.280	.336	.349	.436	.524	.503	.635	.755
60		.035	.044	.053	.063	.078	.094	.090	.112	.135	.141	.176	.211	.184	.229	.276	.228	.284	.342	.355	.444	.535	.512	.645	.769
75		.036	.045	.054	.064	.079	.096	.092	.114	.137	.143	.179	.214	.186	.233	.280	.232	.289	.348	.361	.452	.543	.521	.656	.783
100		.037	.046	.055	.065	.081	.097	.093	.116	.140	.145	.182	.218	.191	.237	.285	.236	.293	.354	.368	.460	.554	.530	.666	.797
150		.037	.046	.055	.066	.082	.099	.095	.118	.142	.148	.185	.222	.193	.241	.288	.240	.299	.360	.374	.468	.565	.539	.677	.810
300		.038	.047	.056	.067	.084	.100	.096	.120	.144	.151	.189	.226	.197	.245	.293	.244	.304	.366	.381	.476	.573	.548	.689	.824
Rack		.038	.048	.058	.068	.085	.102	.098	.122	.147	.153	.191	.228	.200	.249	.299	.248	.310	.372	.387	.483	.580	.557	.700	.836
Face		1⅛"	⅞"	1 1/16"	1 1/16"	1 5/16"	1 9/16"	1¼"	1 9/16"	1⅞"	1 9/16"	2"	2⅜"	1 13/16"	2¼"	2 11/16"	2"	2½"	3"	2½"	3⅛"	3¾"	3"	3¾"	4½"

To find the circular pitch c or diametral pitch p and the face width f:

Divide the known load W by the permissible greatest fibre stress s; find the resulting value k in the body of the table in line with the number of teeth in the pinion. Use the pitch given at the top and the face width given at the foot of the column.

Example: A gear of eighteen teeth is loaded with 495 pounds per tooth; the permissible fibre stress is 3,000 pounds per square inch.

Then $\frac{W}{s} = \frac{495}{3{,}000} = 0.165$. Opposite eighteen teeth find $k = 0.167$ under a diametral pitch 3.5 and over a face width of 2".25.

Or find $k = 0.166$ under a circular pitch of 1 inch and over a face width of 2 inches. Either solution will do.

longitudinal feed of 20 inches. The halftone, Fig. 1, gives a good general idea of the machine, the foreground showing a piece the long cross slots of which have been made by it.

It will be remembered that the cutting bar of the keyseating machine—the cutting being done by a downward pull—is operated by a vertical rack, the pinion which drives it and the connected train of gearing being reversed similarly to the shipping of a planer, except that the adjustable dogs which determine the arm, extending horizontally to the left, is slotted for the purpose of adjusting the feed, which may thereby be made to take from one to three notches on the pinion above. The connection to the feed screw is so clearly shown, especially in the halftone, as to require no explanation. From the third projection *c* of the rocking arm extends the vertical connection *l* to the lever *k*, and from the other end of lever *k* the short connection *j* attaches to the center pin of the toggle joint *i i*. One end of this toggle joint is attached to a

fixed lug on the frame, and the other end to a lug upon the horizontal table slide, and a movement of 1-16 inch or so is given to the table and the work upon it, sufficient to effectually clear the tool upon its up-stroke. The feed and clearance movements occur both at the beginning of the tool reversing movement, and while the pinion shaft is under full power.

The horizontal bracket guide above affords an excellent support for the upper end of the cutter bar. It may, of course, be adjusted at any hight required. The cutter bar used is rectangular in section, and fitted into a round sleeve, and clamped into the head of the ram. A round sleeve with a rectangular groove is also used in the upper guide. The machine is supplied with an oil tank, and when working steel the oil is used freely, a pan underneath catching the oil and chips, the oil being recovered by a separator. The table is 16 inches wide by 38 inches long, with, as was stated, a feed of 20 inches. The machine is built by Baker Brothers, Toledo, Ohio.

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"The Engineer" now says our war making is ludicrous. These things depend so much upon the point of view. To us "The Engineer" is ludicrous.

Table of Strength of Cut Gear Teeth.

BY HENRY HESS.

This was prepared to allow the pitch and the face to be found with very little arithmetic.

It is based on Lewis' method of calculating the strength of gear teeth; by this method the influence of the number of teeth in the gear on the thickness of the tooth is taken into consideration as well as the character of the tooth profile curve.

As the bulk of gears in use are either 15 degrees involute or cycloid, the table has been made up of these forms.

The arrangement of the table is such that, given the number of teeth in the gear, and the quotient obtained from dividing the working load per tooth by the greatest fibre stress, the pitch and face width can be directly picked out. The face width is given in inches and also as a ratio to the circular pitch; it is usual to make the face from two to three times the circular pitch; 2.5 is a fair average. For overhung gears 2 to 2.5 is proper; for gears supported on both sides 2.5 to 3 is good practice. For convenience sake these ratios are repeated at the tops of the vertical columns, while the face widths to the nearest sixteenth higher corresponding to each ratio for each pitch are given at the foot of the various columns.

As diametral pitches are generally used for light work the table is arranged for these from 8 to 3.5, and for heavier work for circular pitches from 1 to 4 inches. The equivalent circular and diametral pitches are marked in lighter faced type.

Speed of Teeth in Feet per Minute....	100 or less	200	300	600	900	1,200	1,800	2,400
Cast Iron.....	8,000	6,000	4,800	4,000	3,000	2,400	2,000	1,700
Steel.....	20,000	15,000	12,000	10,000	7,500	6,000	5,000	4,300

TABLE OF SAFE WORKING STRESSES s IN POUNDS PER SQUARE INCH FOR DIFFERENT SPEEDS.

15 DEGREE INVOLUTE; ADDENDUM = .31831 c.

$$\frac{W}{s} = c^2 r y$$

per square inch. c = circular pitch, inches. p = diametral pitch. r = ratio $\frac{\text{face}}{c}$

number of teeth and odontoid.

1".5		1".75			2"			2".25			2".5			3"			3".5			4"			c
2.094		1.795			1.571			1.396			1.256			1.04			0.897			0 785			p
2.5	3	2	2.5	3	2	2.5	3	2	2.5	3	2	2.5	3	2	2.5	3	2	2.5	3	2	2.5	3	r	No. of Teeth
.378	.452	.410	.496	.616	.536	.670	.804	.679	.846	1.018	.838	1.048	1.258	1.208	1.509	1.811	1.642	2.052	2.462	2.146	2.683	3.217		12
.395	.472	.429	.535	.643	.560	.700	.840	.706	.885	1.062	.875	1.094	1.310	1.260	1.572	1.890	1.715	2.142	2.573	2.240	2.800	3.360		13
.407	.486	.442	.552	.662	.576	.720	.864	.726	.911	1.092	.898	1.125	1.350	1.296	1.620	1.944	1.762	2.205	2.646	2.304	2.880	3.456		14
.423	.506	.460	.575	.687	.600	.752	.900	.758	.951	1.135	.938	1.175	1.406	1.350	1.689	2.025	1.838	2.300	2.755	2.400	3.004	3.600		15
.434	.519	.471	.590	.706	.616	.771	.923	.777	.975	1.170	.965	1.205	1.443	1.386	1.734	2.076	1.883	2.303	2.825	2.464	3.088	3.692		16
.451	.540	.491	.613	.736	.640	.800	.960	.810	1.013	1.214	1.000	1.250	1.500	1.440	1.800	2.160	1.960	2.450	2.940	2.560	3.200	3.840		17
.459	.560	.510	.636	.762	.664	.830	.995	.840	1.050	1.280	1.038	1.298	1.555	1.494	1.869	2.238	2.034	2.545	3.052	2.652	3.440	3.980		18
.491	.587	.532	.667	.799	.696	.870	1.045	.880	1.100	1.320	1.088	1.358	1.633	1.566	1.956	2.350	2.128	2.665	3.197	2.776	3.480	4.176		19
.508	.606	.552	.690	.826	.720	.900	1.080	.911	1.139	1.362	1.125	1.408	1.685	1.620	2.028	2.430	2.205	2.758	3.304	2.880	3.600	4.311		20
.521	.623	.563	.703	.846	.736	.922	1.106	.930	1.162	1.402	1.150	1.440	1.726	1.653	2.070	2.488	2.254	2.825	3.385	2.944	3.684	4.420		21
.532	.634	.575	.722	.863	.752	.941	1.128	.952	1.188	1.425	1.175	1.470	1.763	1.689	2.118	2.538	2.303	2.881	3.455	3.008	3.760	4.508		23
.550	.654	.593	.742	.890	.776	.972	1.166	.980	1.227	1.470	1.213	1.515	1.818	1.743	2.184	2.619	2.377	2.975	3.566	3.104	3.884	4.776		25
.566	.675	.613	.767	.902	.800	1.000	1.200	1.012	1.264	1.518	1.250	1.563	1.875	1.800	2.250	2.700	2.450	3.063	3.675	3.200	4.000	4.800		27
.578	.688	.626	.781	.938	.816	1.020	1.224	1.035	1.290	1.545	1.278	1.592	1.913	1.836	2.298	2.751	2.506	3.126	3.745	3.264	4.080	4.892		30
.593	.703	.640	.795	.955	.836	1.040	1.248	1.057	1.321	1.583	1.305	1.626	1.950	1.881	2.360	2.808	2.562	3.185	3.822	3.340	4.160	4.960		34
.606	.723	.656	.815	.982	.856	1.068	1.286	1.085	1.355	1.628	1.340	1.670	2.008	1.929	2.406	2.889	2.625	3.276	3.937	3.432	4.280	5.136		38
.624	.743	.674	.843	1.012	.880	1.100	1.302	1.113	1.390	1.670	1.375	1.720	2.065	1.980	2.475	2.970	2.695	3.367	4.043	3.520	4.400	5.280		43
.635	.755	.689	.855	1.030	.896	1.120	1.344	1.135	1.416	1.698	1.400	1.750	2.097	2.016	2.517	3.015	2.744	3.427	4.105	3.584	4.480	5.364		50
.645	.769	.700	.871	1.045	.912	1.136	1.368	1.151	1.440	1.725	1.425	1.778	2.138	2.052	2.559	3.069	2.793	3.479	4.182	3.648	4.530	5.460		60
.656	.783	.711	.888	1.065	.930	1.157	1.392	1.175	1.463	1.762	1.450	1.813	2.175	2.088	2.604	3.126	2.842	3.543	4.259	3.712	4.624	5.556		75
.666	.797	.725	.904	1.085	.944	1.177	1.416	1.195	1.486	1.792	1.475	1.844	2.213	2.124	2.649	3.168	2.891	3.605	4.333	3.776	4.720	5.652		100
.677	.810	.735	.918	1.105	.960	1.197	1.440	1.215	1.515	1.821	1.500	1.875	2.250	2.160	2.694	3.234	2.940	3.668	4.410	3.840	4.800	5.748		150
.689	.824	.749	.934	1.121	.976	1.318	1.464	1.238	1.540	1.850	1.525	1.905	2.284	2.196	2.739	3.291	2.989	3.731	4.486	3.904	4.872	5.844		300
.700	.836	.761	.950	1.140	1.192	1.340	1.488	1.260	1.565	1.880	1.550	1.938	2.325	2.238	2.787	3.345	3.052	3.797	4.563	3.968	4.960	5.940		Rack
3¼"	4½"	3½"	4⅜"	5¼"	4"	5"	6"	4½"	5⅝"	6¾"	5"	6¼"	7½"	6"	7½"	9"	7"	8¾"	10½"	8"	10"	12"		Face

To find the greatest fibre stress s:

In the column headed with the pitch used and marked with the face width used at the foot, find opposite the tooth number a constant. Divide this into the working load imposed on the tooth to get the greatest fibre stress.

Example: The working load on a tooth of 4-inch circular pitch and 10-inch face in a 100-tooth gear is 28,000 pounds. Opposite 100 teeth, under $c = 4$ inches and over $f = 10$ inches, find 4.684. Dividing this into the load gives $\frac{28,000}{4.684} = 5,970$ pounds per square inch greatest fibre stress.

Directions and examples are given at the foot of the table.

The formula from which the tabular values were determined is

$$k = \frac{W}{s} = c^2 r \left(.124 - \frac{.684}{n}\right)$$

which is but another way of writing the formula given by Mr. Lewis in the "American Machinist" for June 22, 1893, which, with the notation changed to agree with mine, is

$$W = s\, c\, f \left(.124 - \frac{.684}{n}\right)$$

the quantity in the parenthesis being the Lewis variable for cycloidal and 15 degrees involute teeth. The change in form is made by introducing for f its value—$c\ r$—as per notation below:

W = working load in pounds.
s = greatest fiber stress in pounds per square inch.
c = circular pitch in inches.
f = face width in inches.
n = number of teeth in pinion.
r = ratio of face width to circular pitch = $\frac{f}{c}$
p = diametral pitch.

[To save our readers the trouble of looking it up whenever they attempt to make use of this table, we reproduce from our issue of May 4, 1893, Mr. Lewis' table of fiber stresses appropriate to cast iron and steel and to different speeds.—Ed.]

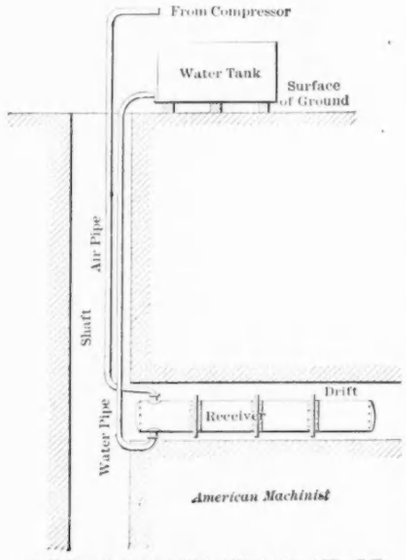
▲ ▲ ▲

Constant Pressure Air Receivers.

BY E. A. RIX.

The value of compressed air for many classes of work arises from the fact that it can be stored in receivers, thus permitting variable work to be done of more or less power than is generated by the air compressor, and permitting the use of a smaller compressor than would otherwise be required to be run at a constant load. This feature of compressed air, however, has not been utilized to the fullest advantage on account of the general ignorance of the advantages which could be gained by storage, and, second, on account of the cost of the receivers to contain the air.

Great efforts have been recently made to improve the quality of air compressors, so that the greatest amount of air can be produced for the least money, and yet this gain is more than counterbalanced by the inefficient method of using the air receivers. It is possible that the idea of using small reservoirs in connection with an ordinary compressed air plant containing intermittent motors arises from a comparison with the small reservoir capacity in steam boilers, and one frequently sees reservoirs about 3 feet in diameter and 12 or 16 feet long attached to 50 horse-power plants for intermittent work that should have from three to five times that capacity. This is not much greater than the steam drum capacity used in a mining plant for supplying a hoist, yet air does not offer the disadvantages which steam does in storage. The larger the storage reservoir in the case of steam the more will be the condensation, until there would soon come a point when it would cease to be advantageous, while with air there is no limitation in that regard. Again, following the example of steam, the receivers installed in various plants which are known to the writer furnish to their intermittent motors air at variable pressure; that is to say, the receivers at the beginning of hoisting will show, say, a pressure of 90 pounds. At the end of the hoist the pressure may have decreased to 60 pounds, to be again recuperated while the hoist is being lowered and the load prepared. The variation of this pressure from 90 to 60 pounds requires



CONSTANT PRESSURE FOR AIR RECEIVER.

the cylinders of a hoist to be able to perform the work at the lower pressure, which means that the hoisting engine has to be considerably larger than is necessary for the work, and the engineer is constantly required to adjust the throttle as the load progresses toward the surface. The result of this is that while most hoisting engines have link motions, these link motions cannot be used to increase the economy of the motor, for if the link should be set in a particular notch at the starting of the load it would have to be changed as the pressure varied in the receiver.

One can readily see, therefore, that a variable receiver presure is undesirable, both as a matter of economy in operating a plant and also in the determination of the proper size of motors. In receivers, as the writer has always found them, the greater proportion of their capacity is unavailable; for instance, if the receiver holds 100 cubic feet at a pressure of 7 atmospheres and the air is drawn from it so as to reduce the pressure to 5 atmospheres, only 2 atmospheres out of the 7 which it originally contained has been available, and 5 atmospheres lie constantly in the tank as a dead capital which can never be used. That is, of course, on the supposition that the motors refuse to do their work at a less pressure than 5 atmospheres. We are thus obliged to install three times the storage capacity which we really require in order to avail ourselves of the one-third for intermittent work. At the present prices of receivers this becomes such a considerable factor in the installation of a plant that the item of proper storage is, as a general rule, disregarded. Everyone who has had occasion to design compressed air machinery has realized this difficulty.

There is a way, however, to overcome this volumetric loss entirely, and in a manner which shall give a constant pressure to the motors, and which shall utilize the total capacity of the air receivers to the last cubic foot which they contain. In general, the idea is this: To install air reservoirs having at their lowest part a fair sized pipe connected to a water tank at a hight enough above them to give the constant pressure that shall be required; the capacity of the tank to be somewhat in excess of the capacity of the receivers.

It will readily be seen that as the air is used from the receivers the water from the tank flows in and maintains in the receivers the constant pressure due to its head. Whenever the excessive draft upon the receiver ceases the compressor replenishes the air, pushing the water back into the reservoir again. The work done in raising the water into the reservoir is restored when it flows back into the tank. If it should so happen that the air is completely drawn from the reservoir a ball float attached to a simple flap-valve closes the eduction pipe and prevents the water from getting into the air pipes, and, vice versa, a similar valve placed at the bottom of the receivers prevents the air from getting into the water pipe when the air receivers are full of air. The sketch accompanying will illustrate this idea sufficiently for anyone to understand it.

Of course for operations other than mining, and in a flat country, such an apparatus might be inadvisable, for it could only be used by building a scaffold or tower of sufficient hight to give the pressure required; but in mining countries there is always an opportunity for its proper installation. If the configuration of the country is not such that a tank can be placed upon the hillside the receivers can always be placed on one of the upper levels, or a drift may be cut out at a proper distance from the surface to give the pressure required, and the tank may be placed at a convenient point near the mouth of the shaft. Inasmuch as the

greatest amount of storage possible is to be desired, and as cost is the only thing which limits it, this method will be found to give at least three times the storage as in other methods, with all the advantages of constant pressure attached.

The writer suggests, to still further cheapen the outlay, that inasmuch as in ordinary receivers the cost of the two heads forms a large proportion of the total, it would be better to build the receiver in sections, of such diameter and length as are most convenient for transportation or for taking down a shaft, and that each section be finished at the ends with a stout angle iron flange containing the proper number of bolt holes. By using a rubber gasket between the sections and bolting them together the receiver may be stretched out as one long pipe to any length that may be required. This will also permit additional sections to be added at any future time. The connections to motors may of course be made anywhere on the pipe from compressor to receiver, or by another pipe from the top of the receiver.

San Francisco, Cal.

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Letters from Practical Men.

Babbitting Split Bushings.

Editor American Machinist:

Recently I have had to babbitt the bushings of several pulleys. The pulleys were 5 feet in diameter and the bushings of the dimensions of the accompanying sketch, Fig. 1. These pulleys drive dynamos, they run at a high speed, and it is obvious that a close approach to absolute accuracy in their centering is very desirable. It should be borne in mind that the wheels were near the center of the line shaft and weigh probably 800 pounds each; they could not, therefore, be twirled around and centered like the balance wheel of a watch; had this been possible, they might have been trued up and babbitted on the shaft. The bushings are split and are a tight fit in the hubs of the wheels, they are held in the hubs by set screws through either end. It will be seen that no strips could be used to divide the babbitt, for the bushing would not then fit into the hub nor on the shaft. I turned up a hardwood mandrel the exact size of line shaft and fitted bell centering chucks on either end, Fig. 2, clamped the split bushing together evenly, slipped it over the mandrel into one bell chuck and then adjusted the other one. My bushing was then absolutely true with the line shaft. I set up the set screws mentioned above firmly against the hardwood mandrel and removed the top bell chuck; then poured the metal into the open end. After pouring I bored out the wood, and, with a narrow saw blade set into a wooden back, sawed the babbitt at the joints. The bushings fitted snugly and the wheels are perfectly true. As I have more of this same work to do, kindly advise me if you know of a more expeditious or better way. J. W. M.

[The destruction of a wooden mandrel for each bushing babbitted seems a useless expense, and we have not unbounded faith in the absolute truth secured by the conical cups in conjunction with the wooden mandrel. It would be so easy to throw the cup one way or the other by the set screws, and a very little inaccuracy at the 4-inch diameter would be much magnified at the 5-foot periphery of the wheel. We venture to suggest the arrangement shown in Fig. 3, which we have used a great many times, especially for babbitting hanger boxes with turned and faced ends. An iron mandrel is provided of a diameter corresponding to that of the shaft. This may be of cast iron and need not be solid. The two collars are then bored to fit the mandrel, and each is counterbored, say, an inch deep to fit the outside of the bushing. The bushings are then poured a half at a time, by laying the ends in the counterbores of the collars and shoving the collars up as close as possible. No clay or anything else should be required at the ends, and if anything was necessary putty would be better than clay, as it does not make steam and blow when the hot babbit touches it. No set screws are needed for the collars if the fit is all right. The bushings should have a few holes through them, especially near the ends and edges, to hold the babbitt. The mandrel and collars should be warmed a little before pouring. This device should bring the bushes truer than is likely to be attained by the previously described method, and there is no sawing of the babbitt and no destruction of the mandrel. The pouring is, of course, done with the mandrel and bushing in a horizontal position, as shown.—Ed.]

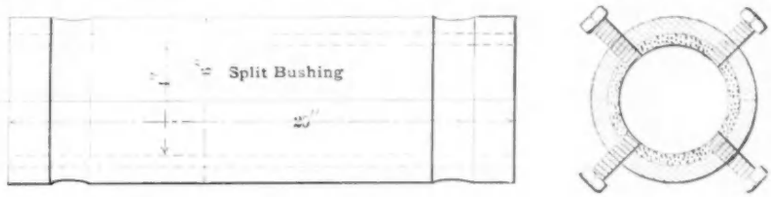

Fig. 1

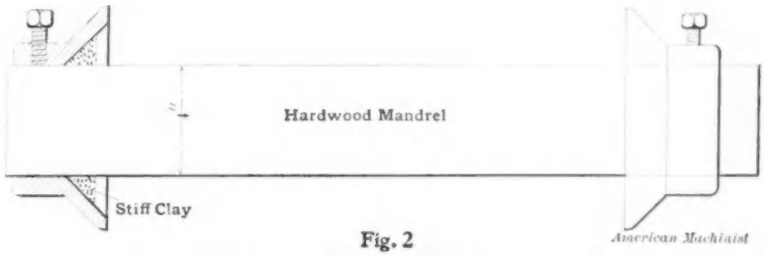

Fig. 2

BABBITTING RIG FOR SPLIT BUSHINGS.

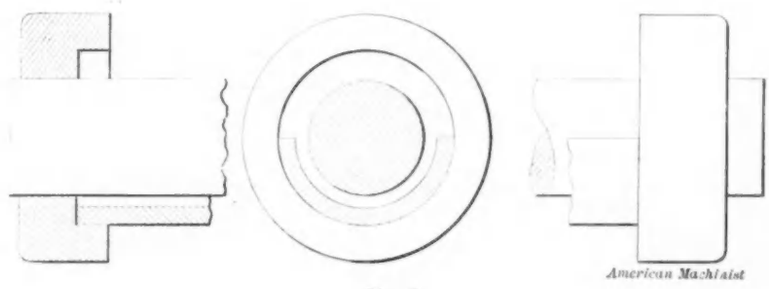

Fig. 3

ANOTHER RIG FOR BABBITTING HALF BUSHINGS.

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Interchangeability with Precision.

Editor American Machinist:

Long words and the fellows who use them are both to be regarded with suspicion. Interchangeability is perhaps the longest word that we encounter with any frequency in mechanical reading. In the numerous discussions which occur as to the conditions of mechanical progress, and in the current laudation of modern methods of manufacture there is much prominence given to the general fact of the interchangeability of parts which is so commonly accomplished. This interchangeability is held to be the most striking feature of the modern output, and also the thing assumed to be most diligently sought for by the manufacturer. I have even seen some discussions in the papers as to who the fellow was who first started the "modern" and largely the

"American" idea of interchangeability of parts.

It seems to me that there is a good deal of nonsense about this. It is quite doubtful whether interchangeability is entitled to the elevated status to which it is so commonly assigned. Interchangeability is by no means so rare or so modern as some would have us believe. All ships fit the sea. Any locomotive or any freight car in the land has a hundred thousand miles of road which its wheels will fit.

Unqualified interchangeability of parts is one of the easiest things in the world to accomplish. The typical bad fit, "a rat's tail in a quart pot," will also equally typify perfect interchangeability. Every rat's tail will surely go into every quart pot. So in manufacture we may have a sample pin and a collar which nicely fit each other, and we may have gages which shall merely insist that no pin shall be larger than the sample, and that the hole in no collar shall be smaller, and absolute interchangeability is assured. Interchangeability is thus in itself no virtue, and does not necessarily carry with it a recommendation. There can be no workmanship bad enough to alone defeat it.

There is, however, another road to interchangeability than that above suggested, and when that road is traversed and interchangeability is still attained there is occasion for gratulation and rejoicing. Under the best modern practice interchangeability is, indeed, secured, but it is a mere incident of accomplishment instead of the one solitary thing sought for and attained. Absolute precision of workmanship, just as surely as wide departure from it, could guarantee interchangeability. "Things which are equal to the same thing are equal to each other." So things which are alike will fit alike in the same place. Produce a thousand pieces alike and let one of these pieces fit as required; you need not try the rest. "Alike" is the key, and the only ultimately permissible key to interchangeability. The excellence and the advantage of modern methods of manufacture are in the ability to duplicate, and all our checks and safeguards are primarily directed to securing repetitions of what is once approved.

Our success is never complete. Interchangeability is always a compromise with precision. Machine work consists to a very large extent in the shaping and sizing of holes in metal, with or without screw threads in them, and then the fitting of solid pieces to the holes. It usually happens that we want at once a great number of each, and then we contrive our various tools for producing them, and at once we are in trouble. Interchangeability is an absolute and indisputable fact when it exists. Things are either interchangeable or they are not, and there is no possibility of anything between. Precision of fit would seem to be equally closely definable, but we have to concede it a certain elasticity. If interchangeability will not yield precision must. No second hole and no second piece is made by any unaltered tool precisely the same as the first, and the third is still different, and so on. If the first pair of companion pieces fit perfectly the second pair will not go together, because the hole is smaller and the pin is larger. We must establish a certain permissible limit, and the best of modern workmanship consists, after all, in the valorous defense of the limit. Eternal vigilance is the price, not of interchangeability, but of approximate precision with interchangeability. The latter by itself is a very cheap thing.

TECUMSEH SWIFT.

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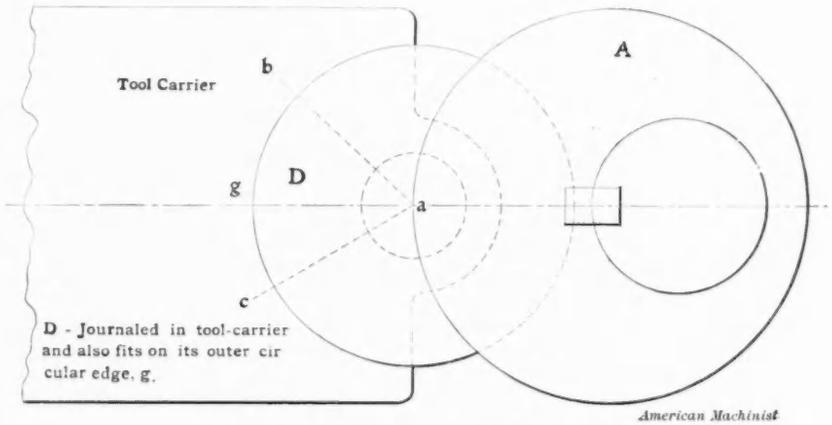
Ellipsoid and Elliptoid Movements.

Editor American Machinist:

In your issue of June 16, under the heading of "Boring and Turning Irregular Shapes," in describing Fig. 4 you say: "If the eccentric were geared two to one instead of three to one the figure produced would be an ellipse," but if you will lay out the figures produced by the "two to one" gear, with different amounts of throw of eccentric, you will doubtless see that it produces more kinds of your so-called ellipses than you ever dreamed of, varying from a circle to a figure 8, and the latter, if my memory serves me, even having internal loops.

I have quite a vivid recollection of once wrestling with a similar attachment designed for turning small elliptical arbors on centers, which attachment utterly failed to produce an ellipse, but what was at the time considered a "near enough ellipse" was eventually obtained by a modification of the mechanism. After making various layouts I found that the eccentric working against a point or sharp edge fixed to the tool carrier, instead of revolving in the sliding box *C*, in the slotted yoke *B*, of Fig. 4, would produce a figure approximating more closely to an ellipse, within the limits the attachment was desired to operate.

The tool carrier was designed to be held in contact with the eccentric by a weight or spring, and to have more than point or line contact was deemed advisable, and this was obtained by pivoting in the tool carrier a crescent shaped shoe, its concave edge in contact with and fitting the face of the eccentric, and its convex edge fitting and working in a semicircular recess in the tool carrier, said concave edge cutting the axis of the pivot and the center of the external convex circle of the crescent or shoe, as shown by the accompanying sketch. Inasmuch as the axis *a* of the shoe remains in the same position in relation to both the carrier and the face of the eccentric, whatever the angular oscillations of the shoe may be it is evident that the movement of the tool carrier is the same as it would be if the concave surface of the shoe were removed to dotted lines *a b*, *a c*, and the shoe then rigidly fixed to the carrier, thereby making the bearing contact a sharp edge one.



A POINT CONTACT WITHOUT THE POINT.

The company in whose employ I was when this device was made had previously built a similar one for turning and cutting internal gears, in which machine the tool carrier and the crank were joined by a connecting rod and rockshaft, and my improvement was the slotted yoke, which it was thought would make the ellipse symmetrical and perfect. The original machine having been designed by the company's czar, supposed to be infallible, no attention whatever was given as to the correctness of the main principle underlying it until the latter device was nearly completed, when, though it was considered high treason to criticise or doubt the reasoning of the aforesaid czar, after some little thinking "on the quiet" I got up in the middle of the night to lay it out and went back to bed "a sadder though a wiser man."

The less throw the eccentric has the nearer the produced figure will be to an ellipse when the slotted yoke device is

used, and, as the internal gears made on the machine herein mentioned were so nearly circular, the figure 8 feature of the device was never apparent, nor were their unsymmetrical outlines plainly discernible, notwithstanding that the connecting rod was used instead of the slotted yoke. CHAS. E. CHURCH.

Norwalk, Conn.

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Turning Irregular Shapes.

Editor American Machinist:

The article on boring and turning irregular forms in issue of June 16 has touched a tender spot. Perhaps you intended that it should. I am inclined to think that the turning of irregular work may be more common than appears. Machinists are so modest! Several years ago I made a quantity of small formed cutters having five deep teeth. They were to be sharpened by grinding on the face of the teeth, and it was necessary that the form and clearance should remain unchanged until the whole tooth was ground away. I made an arbor with a nut on the end to hold the cutter blank against a

FIGURES FROM A TWO TO ONE ECCENTRIC MOVEMENT.

shoulder, and near the dog end of the arbor I put on a cam having five depressions around the periphery, shaped to give the right clearance to the cutter. A forming tool in the post of the compound rest, with the nut of the lower slide disconnected, as when using the taper attachment, and a roll on a bracket fastened to the cross slide and held against the cam by a spring completed the rig. The roll followed the shape of the cam and the motion of the tool to and from the center line of the latter produced the required shape and clearance on the cutter blank.

Two years ago I wanted a number of oval cams nearly elliptical in form, and devised an arrangement almost exactly like that shown in your article except that I used a roll held on a bracket on the cross slide, instead of a connecting rod, to communicate the motion of the eccentric to the tool. I have not worked out the motion obtained with the construction you give, which you say will give an ellipse. The connecting rod of infinite length will give the outline I obtained with a roll, which is not an ellipse, being too full near the ends of the oval and becoming hour-glass in shape as the tool is moved toward the center. I send an impression of a piece of iron that was faced and marked with a tool at various distances from the center. The four lobed figure in the center was made with the tool on the center when the eccentric stood at one-half its throw. The next curve was made with the tool on the center when the eccentric was furthest back.

C. E. QUIMBY.

Tilton, N. H.

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Countershafts Wrong Side Front.

Editor American Machinist:

Under the heading "Countershaft Wrong Side Front" Mr. Edmund Stevenson calls attention to the large half-tone of the flat turret lathe used as a frontispiece in your paper May 19.

There seems to be no chance, hence no disposition, to dodge the well directed criticism. It is not good practice to put up countershaft hangers with the open side toward the main line shaft, on account of the danger of belts winding on an overcrowded main line, but in this case there seem to be some mitigating circumstances.

The countershaft employed is one so constructed that it must always stand in a fixed relation to the machine, regardless of the pull of the belts, and has been made doubly strong for this purpose. The advantage resulting from this construction is in the use of only one shipper lever for the three frictions. The hook-shaped hanger seems to be the most convenient construction for erection, and the element of danger is very small where the main line is not overcrowded.

Brother Stevenson, in his criticism of of an advertising cut, has bridged over the gap that has previously protected the advertiser from the critic's attack, and my joy over this point is so great that I almost forgot having been caught napping. JAMES HARTNESS.

Springfield, Vt.

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Pickling Castings.

Editor American Machinist:

The recent discussion as to the pickling of castings having elicited considerable comment, will you kindly permit a few words as to the practice here. Nearly all the castings are pickled, only those required in the shortest possible time are "faced," so as not to require it

The process of pickling as here practiced is to make the solution of one part acid to three and one-half parts water for summer use, and one part acid to three parts water for winter use. This pickle is poured over the castings, which have previously been laid out on an inclined platform covered with thick sheet lead, from which the solution drips back into the vat of solution. The operation of pouring on the pickle (from a long handled ladle) is repeated in three hours, again in three hours more. At the end of another three hours they are thoroughly rinsed with water, cold in summer, but hot in winter. Very small castings may be immersed in the pickle for four hours and then rinsed. It is very important that the washing or rinsing should be very thorough, otherwise the traces of acid remaining will continue to work and the result will be to show a white powder in spots, particularly in the least accessible places. This must be carefully cleaned off before painting, as it will, in time, cause the paint to scale off. This may occur a month or two after the job is finished and painted.

OSCAR E. PERRIGO.

New Haven, Conn.

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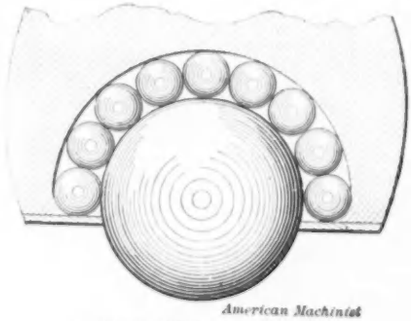
Patenting Impossibilities.

Editor American Machinist:

The communication of Mr. R. D. O. Smith, issue of June 16, is rather ingenious and not a little amusing. His contention is that the Patent Office is precluded by the Supreme Court from inquiring into the utility of any alleged invention coming before it for its decision as to patentability; and that a solicitor is simply foolish who calls his client's attention to the impracticability of his device. You ask for the production of any law authorizing the issuance of a patent for an inoperative device. There is no such law. Neither do the decisions of the Supreme Court limit the examiners in the Patent Office in their inquiry as to the operativeness of any invention. On the contrary, the law makes the commissioner, whose subordinates they are, practically the supreme judge



American Machinist

A BALL BEARING CASTOR.

of all these questions. It is true that if the office finally refuses to grant a patent in any case the matter may be carried into a court of equity, but in no other way can the patentability of an invention be reached for consideration by the Supreme Court until after a patent has issued. Then the court, with a view to sustaining the patent if possible, simply declares that the fact of a patent having

been granted is *prima facie* evidence of utility. That is all. The question of utility may be raised at every step in the progress of the application and even after the patent is granted. As a matter of fact it is raised every day by the examiners in the Patent Office.

In the case of the "roller skate" patent referred to in the "American Machinist" of April 14, it looks as though the official allowance might have been made by the office boy while the examiner was at luncheon. You are quite right. That thing is utterly destitute of the attributes of patentability. There is, however, this to be added: The Patent Office has for years been granting patents for ball casters embodying somewhat the principle of the roller skate in question, but with this difference: The seat for the small balls is commonly hemi-spherical and concentric with the large ball, which projects through a hole in a retaining disk, as illustrated in the accompanying sketch. I presume I have noticed fifty patents for analogous devices. If they are of any practical value I have yet to learn it, but there is a possibility of movement here on the part of the small balls which does not apply to the roller skate. It looks as though the skate patent might have been allowed as embodying another change rung on this idea, and with a view to consistency. But the examiner might with perfect propriety have said: "The application is rejected as claiming an inoperative device, and this action is made final." The applicant then, if he were foolish enough, might have pursued it to the board of examiners-in-chief, to the commissioner, or into a court of equity. But none of these tribunals is bound by any statute law or legal precedent to ignore the question of utility simply because the applicant has taken the regularly prescribed oath.

There is some truth in the statement that a solicitor who exposes to his client the absurdity of his invention is likely to lose a client and a fee. But Mr. Smith greatly exaggerates the danger, as I think he does the relative importance of that same fee. In my practice during the past sixteen years I have never hesitated, when the occasion justified it, to point out a mechanical absurdity, in spite of both client and fee. In some cases the client has taken the bit in his mouth, and insisted on my filing an application. In other cases he has gone out in a huff, but in process of time he has come back to thank me, with a larger fee in his pocket and a better idea in his head. In one of the exceptional cases he did not take good advice, and a good farm, the earnings of a lifetime, is being squandered to demonstrate the feasibility of a perpetual motion as applied to a road vehicle. But whether he goes or stays I cannot see that the solicitor is absolved from the obligation of giving his client good counsel if he will be fair enough to pay for it, or to positively decline a case which he knows to be unpatentable or the subject matter of which he knows to be inoperative, unless, after full information, the inventor himself shall assume the responsibility of ordering it done.

J. M. St. John.

Cedar Rapids, Ia.

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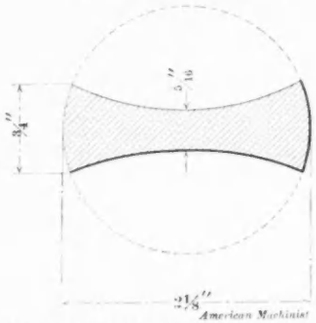
Drilling Long Holes.

Editor American Machinist:

In my article entitled "A Job of Boring," in your issue of January 16, your types make me say, "Given the task of boring a 5/8-inch hole endwise through a hard steel spindle 7½ inches in diameter



SECTION OF HOME MADE TWIST DRILL.

and 5 feet long." It should have read 5⅛ inches in diameter, instead of 5/8 inch.

In editorial comment you refer to the kind of drill used in boring the initial hole so accurate as to meet "quite exactly" in the center.

The 2-inch drill was one forged in the blacksmith shop here. It was forged straight, and of the cross section shown in the sketch and then twisted to one turn in 20 inches, centered and turned up in the lathe and the concave sides finished by filing. No directing hole was bored before using this drill, the work being only centered, with a flat centering drill, which left a center of about 1 inch diameter at the surface. The drill was ground as accurately as possible, and no difficulty was experienced and no delay occasioned in its work.

The intention in writing the article was not to advance theories, but to give briefly the result of practice, after the job was completed. It seems pertinent to the question to remark, however, that we are boring many of these spindles and for several years it is not recalled that in more than two cases have the holes failed to meet properly, although, of course, they were not so long as this one, being usually from 24 to 37 inches long and from 1.3 to 2.1 inches in diameter. The job described being one of unusual diameter and length seemed worthy of record.

Oscar E. Perrigo.

New Haven, Conn.

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Forming Lathes.

Editor American Machinist:

Manufacturers of the class of machinery described in your paper of May 26, on page 20, should adopt some other name than "forming lathe" for their productions.

The original forming lathe was put on the market by the firm of Williams & Booth, of Meriden, Conn., of which our present company is the successor, and the lathe was—and is—almost exactly opposite to the class of machinery which you illustrate, and it is not only confusing, but, under the circumstances, unfair to apply the name to any but the original forming lathes, as now made by this company.

Of course, from a dictionary standpoint, the lathe you show is a forming lathe, but from a mechanical ethical standpoint the case is very different, and we feel that we have a sort of moral copyright on the name as well as the machine.

The Meriden Machine Tool Co.,
W. L. Cheney, Secy.

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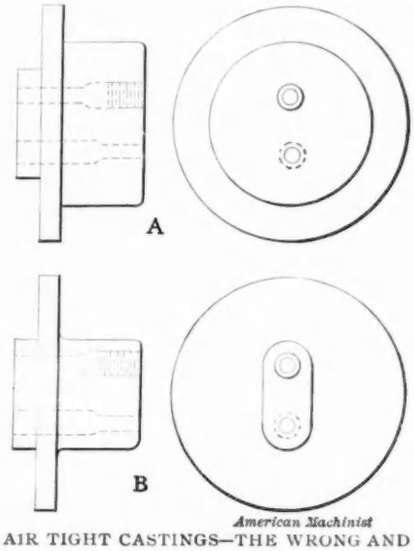
Making Air-Tight Castings.

Editor American Machinist:

In your issue of June 16 P. A. asks for a metal to stand high pressure. Permit me to say that the shape of the casting has much to do with it. Make the casting of bronze and as thin as possible



AIR TIGHT CASTINGS—THE WRONG AND THE RIGHT WAY.

to stand the breaking strain, and core large, allowing as little as possible for finish. In pieces made as in sketch *A* the air came through the metal in a fine shower, while when made as in *B*, with the valve parts cored and with a small amount of finish, they were satisfactory.

Edmund Stevenson.

Stamford, Conn.

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Improved Boring and Turning Mill.

The Baush & Harris Machine Tool Company, of Springfield, Mass., have introduced in their later boring and turning mills an improvement which is shown by the accompanying diagram, and which

seems well calculated to very much simplify a machine shop problem that is often somewhat bothersome.

Sometimes when the new boring mill arrives the possible positions in which it can be set are limited by the fact that the cone pulley and driving belt must occupy a certain position with respect to the rest of the machine, and this unchangeable position often effectually prevents the mill from being put in what would otherwise be the best place for it, or involves the construction of awkward and expensive transmitting devices.

By this new arrangement the cone pulley and the driving shaft may be placed at either side of the machine or at the back between the housings, as may be most convenient, and the machine may be thus ordered to fit the position in which it is to stand.

It will be noticed that the center lines converge at the center of the upright shaft carrying the table gear pinion and any one of the three different positions indicated is arranged for without material alteration in any other respect.

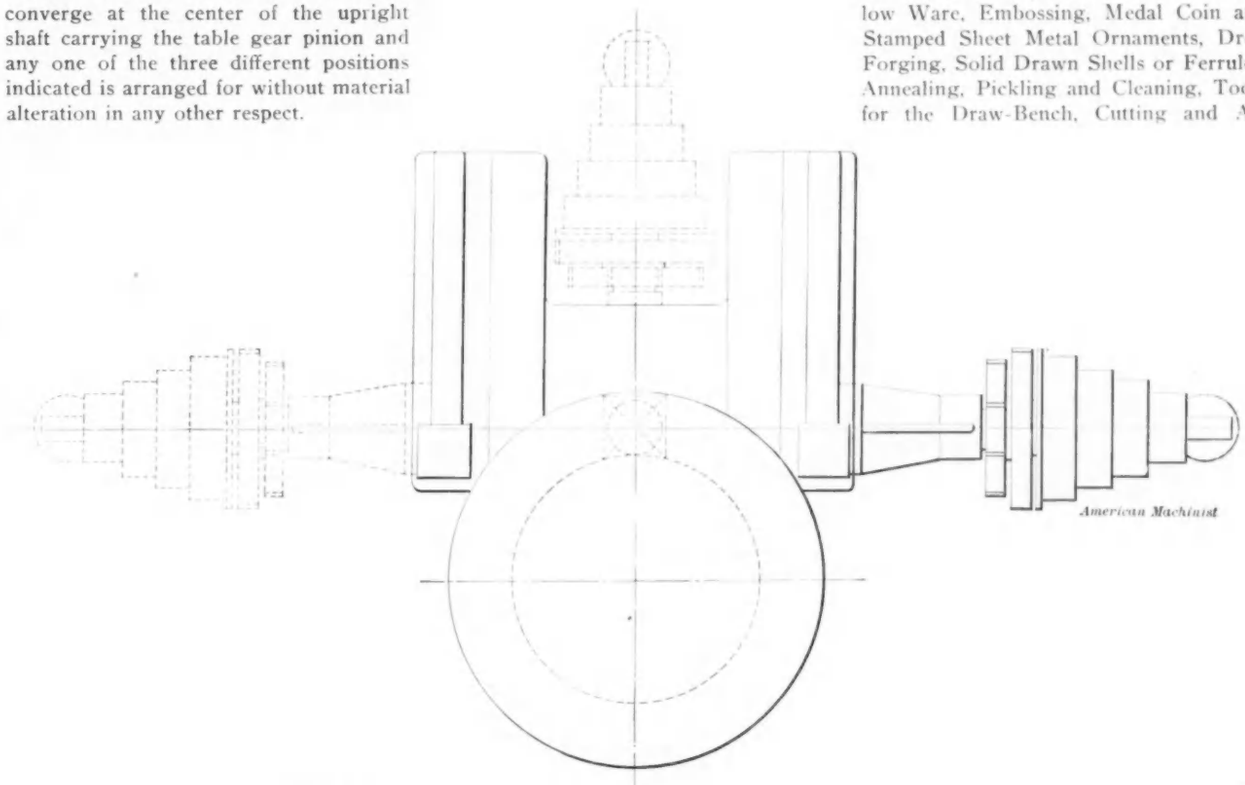

DIAGRAM SHOWING ARRANGEMENT OF DRIVING SHAFT FOR BORING AND TURNING MILL.

Technical Publications.

LIGHTING BY ACETYLENE. By Wm. E. Gibbs. 141 5x7½ inch pages, with 66 illustrations. D. Van Nostrand Company. Price, $1.50.

This book may be described briefly as a record of what has been done to date in the use of acetylene gas. It contains a clear account of the properties of acetylene, including a frank statement of its dangers and the conditions that must be observed to avoid them. The various forms of apparatus that have been devised for the generation of the gas are classified and described, as are the burners that have been proposed for its use.

The author considers that the ease with which acetylene may be generated in quantities sufficient for demonstrative purposes, and the fact that the performance of the crudest and most flimsy generator may be for a time satisfactory, has had an unfortunate result in the production of a class of apparatus which cannot be permanently successful. While, however, the book is in no sense an attempt to boom acetylene, one cannot read it without a feeling that the gas has decided merits as an illuminant and that it has a future before it. The concluding chapter of the book gives the requirements of the New York Board of Fire Underwriters for the construction and location of acetylene generators.

THE PRACTICAL TOOL-MAKER AND DESIGNER, By Herbert S. Wilson, M. E. 209 6x9 inch pages, 189 illustrations. Philadelphia, Henry Cary Baird & Co.: London, Sampson Low, Marston & Co. Cloth, $2.50.

This book is written by a practical mechanic who has been a contributor to our columns, and much of the matter to be found in it is very similar in character to that we are publishing from week to week. It is, however, more systematically arranged than is possible in a periodical, and is accompanied by a good deal of elementary matter which a journal must either print at frequent intervals for the benefit of new readers or omit altogether. Many of the illustrations used in the book will appear familiar to those who read this paper; but, on the other hand, there are very many new ones made from original sketches or drawings by the author, and these particularly, with the explanations accompanying them, must prove of very great value to any ambitious member of the craft whose experience has not covered so wide a range as that of the author, and we may add that comparatively few tool-makers had opportunities for becoming acquainted with as many branches of the work as are here treated. Following an interesting introductory chapter there are others on the Modern Tool-Room and Its Equipment, Files and Their Use and Abuse, Steel and Tempering, Making Jigs, Milling Machine Fixtures, Tools and Fixtures for the Screw Machine, Broaching, Punches and Dies for the Cutting and Drop Press, Tools for Hollow Ware, Embossing, Medal Coin and Stamped Sheet Metal Ornaments, Drop Forging, Solid Drawn Shells or Ferrules, Annealing, Pickling and Cleaning, Tools for the Draw-Bench, Cutting and Assembling Pieces by Means of Ratchet Dial Plates at One Operation, The Header, Tools for Fox Lathe, Tools for Making a Bicycle, The Plater's Dynamo. Some of the subjects treated are, so far as we know, here put into print for the first time, and we think no tool-maker or other person who wishes to be well informed should be without the book. We cannot say much for the quality of engravings used, and the author has in some cases not included as many details in his drawings as would be found useful by most of his readers, and has in other cases made one view of a die or other tool answer where two or more views would have been much better.

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The Non-Combatant.

The art of war, the conditions under which wars are waged, and the means by which battles, especially on the sea, are won, have undergone a complete transformation in modern times, while some of the terms employed in connection with the affairs of war have not been changed to correspond. There is perhaps no word which is at the present time the instrument of more injustice or which is in more need of correction as to its meaning and application than the above. By a non-combatant is of course meant one who, while a more or less necessary adjunct of the military equipment, is still not a fighting man. As he is not a fighter he of course does not incur the fighter's danger, and is little entitled to a share in the glory or in the substantial rewards of victory. The word distinctly stamps the man to whom it is applied as, if not actually a coward, at least as one who does not incur the supreme danger of the battle's front, and is not every inch a warrior. It is an added wonder when one who bears this deprecatory designation finds opportunity for a deed of successful daring which ranks him with the heroes of the ages.

Non-combatant Hobson is a non-combatant nevermore. But the fact is that he and such as he are classed and designated wrong from the beginning. If there be one thing more than another which makes a man a combatant it is the deliberate and voluntary facing of the dangers of battle for the purpose of winning the battle. All who help to handle the gun are combatants as well as he who sights the piece or pulls the lock lanyard or touches the firing button. The ship is now nothing more than the mounting of the gun. The working of the ship is but the conveyance and manipulation of the gun. It is not clear that the stokers and coal passers, and especially the engineers, are not as truly combatants as the man in the conning tower. And when it comes to the minute and unwinking devotion to duty that is evidenced in the maintenance of engines and machinery in effective working condition, the constant endurance of the hard conditions of actual service, the simmering atmosphere of the stoke hole or the engine room, and the standing at post as the watches slip by without relief, the unflinching facing of death in its most sudden and terrible shape, with practical certainty that when catastrophe comes not even the deck can be reached, and there can be no chance even to try for life, history tells of nothing that man has done more heroic. There is little use for the word non-combatant on a modern ship of war, and least of all as applicable to those whose post is always below the deck to keep the vital forces of the craft alert.

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An English friend sends us clippings from Birmingham papers which show that one of the features of the Barnum & Bailey show, now over there, that attracts most attention is not included in the show proper at all, but is the cars that have been built for transportation of the show from place to place. They are fitted with automatic couplings, and these seem to be attracting great attention and also general commendation. English "shareholders" and others are asking why English cars cannot be equipped with them, and are pointing out the advantages that would result from their use, especially in respect of decreased liability for accidents to trainmen.

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The unwisdom regarding measures and gages is not entirely confined to strictly mechanical lines nor to this country alone. There are in England 110 different measures of grain in daily use. In Hereford a bushel is 62 pounds; in Monmouth, 80; in Shropshire, 75; in Wenlock, 73 1-3 pounds. There are 50 different bushels for wheat, 25 for barley and 38 for oats. A bill to require that all grain be sold by the hundredweight was rejected lately by the British Parliament. The prevailing argument seemed to be that the present heterogeneous system, although bad enough, was not intolerable.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

(70) C. A. M., Kansas City, asks: 1. Does an induction coil add to the spark producing qualities of galvanic batteries? A.—Yes. You cannot get a spark of any appreciable length from an ordinary battery without such a coil. 2. How can I make a dry battery? A.—Most of the good dry batteries are patented. You had better buy than try to make one, but if you are anxious to try it, get a copy of one of the patents. This is easily done from the number or date printed on the label of the battery you want to make.

(71) A. W. R., Haffey, Pa., writes: Please inform me how brass springs are tempered, or is it in the composition which gives them their elasticity? A. We suppose you refer to springs made of brass wire, and the temper of these is derived from the fact that the wire is hardened by the drawing operation and is not subsequently annealed. Flat or sheet brass possesses elasticity for the same reason, that is, it is rolled and hardened by the rolling and retains this hardness and elasticity unless it is annealed. In other words, unannealed brass wire or sheet brass made into the form of a spring will possess elasticity.

(72) P. C., Pittsburg, Pa., says: In a 6-inch wrought iron pipe line, with natural gas flowing through at velocities ranging from 275 to 515 feet per second, there are two pieces of ⅛-inch brass pipe inserted of an external diameter of ⅜ inch. One piece runs in 4½ inches from the inside wall of the 6-inch line, the other 2¼ inches. In calculating the cubic feet of flow should allowance be made for their area; if so, how much? A.—Short obstructions of this kind offer but slight resistance to the flow of gases. We have known diaphragms to be inserted in pipes to test the matter, and the results showed that the opening in the diaphragm must be surprisingly small to produce a sensible effect. We do not think that your small pipes would make a difference in the delivery sufficient to measure.

(73) "Beginner," Dursley, England, asks us to explain the method of finding the bursting strain on a fly wheel or drum due to centrifugal force. A.—The total centrifugal force of the whole rim is

$$F = \frac{W v^2}{g R}$$

in which

F = centrifugal force of the entire rim, in pounds.
W = weight of entire rim in pounds.
v = velocity of rim in feet per second
R = mean radius of rim in feet.
g = acceleration due to gravity = 32.2.

In finding the force acting to rupture the rim on any diameter we see that the force

due to one-half of the rim only acts since the force due to the other half merely supplies the reaction to prevent displacement. Moreover, the centrifugal force acts radially, and only the component perpendicular to the diameter acts on the section. To obtain this component we divide half the total centrifugal force by

$$\frac{\pi}{2} = 1.5708.$$

Again the force thus found acts on two sections of the rim, and to find the force acting on one section we must divide by 2 again. The resulting formula for the strain on any section is

$$F = \frac{W v^2}{g R \times 2 \times 2 \times 1.5708} = \frac{W v^2}{202.319 R}.$$

(74) T. F. H., Wellington, B. C., asks: 1. How is the size or area of an air chamber found for a pump, say a double acting pump with rams 8 inches diameter and 18 inches stroke? A.—There is no rule and no fixed practice that we know of in the matter. The air chamber cannot be too large, and if of a capacity equal to, say, four times that of a single stroke of the pump it should usually be large enough. Thus the capacity per stroke of the pump cylinder would be $8^2 \times .7854 \times 18 \div 1728 = .523$ cubic feet. Then an air chamber with a capacity of 2 cubic feet would be as large as would usually be provided. 2. Does air under high pressure lose any of its elastic properties? A.—Never until it liquefies, and this does not occur except at pressures above 2,000 pounds in combination with a temperature of more than 200 degrees below zero. 3. Under high pressure through which would air find its way the easiest, cast iron or water? A.—It should not find its way through either. It will not pass through cast iron if the casting is sound and of reasonable thickness, and it, of course, could not pass through water without passing also through the pipe or receptacle containing the water. 4. We have a double-acting steam pump on which the air chamber seems to lose its power after running a time; can you suggest the cause and a probable remedy? A.—The disappearance, partial or total, of the air in the air chamber does not necessarily imply a leaking out of the air, as the previous questions seem to suggest. It is a not unusual experience to find the air disappearing from the air chamber, especially when working under considerable head, as is probable in the present case, if the pump dimensions in the first question apply. When air is confined under pressure and in contact with water the water will absorb some portion of the air unless it is already fully aerated. Every time the pump is started it is always possible to know that the air chamber is full of air by having two pet-cocks, one at the top and one at the bottom of it, and having them open until water ceases to flow out of the lower one, and then closing both before starting the pump. When the full pressure is on the air in the chamber is, of course, compressed to a very small portion of its original volume, so that a larger air chamber is required for high pressure pumping than for low pressure. The disappearance of the air by absorption may be compensated for, and the air chamber may be kept full of air by having a pet-cock in the suction pipe to admit, by a minute opening, a little air, which will be carried along with the water and may be expected to collect in the air chamber. Such admission of air will, of course, impair the suction, but if the water is not drawn more than a few feet no trouble should ensue. This admission of a little air into the suction is quite frequently done, and in many cases, especially with electrically driven pumps, the entire action of the pump is made smoother and easier by it.

(75) L. M., Oshkosh, Wis., says: In Mr. William Norris's "Practical Treatise on the Otto Cycle Gas Engine," page 75, there are some formulas for fly wheels as follows:

Let

W = weight of wheel in cwt.
D = outside diameter of rim in feet.
V = volume in cubic feet swept by piston.
P = M. E. P. of working stroke.
C = constant.
R = revolutions per minute.

Then

$$W = \frac{1}{D^2} \times \frac{1}{R^2} \times V \times P \qquad (1)$$

that is,

$$W = \frac{V P}{D^2 R^2} C \qquad (2)$$

or

$$\frac{D^2 R^2 W}{V P} = C \qquad (3)$$

Apply this to the following case:

W = 3,000 pounds.
D = 6 feet.
V = 1.2 cu. ft. (cyl., 11½ diam., 20-inch stroke).
P = 70 pounds.
C = 125, as given in book.
R = 180.

Substituting the figures in formula (2) we have:

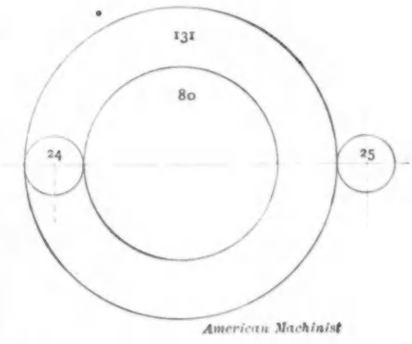
$$\frac{1.2 \times 70}{36 \times 32400} \times 125 = .009$$

weight of wheel, which should be 3,000 pounds. Again take formula (3),

$$\frac{36 \times 32400 \times 3000}{1.2 \times 70} = 41{,}657{,}154. = C$$

which should be 125. Will you please explain where the mistake is? A.—The formulas are all wrong. The value given for the constant is altogether too small, as you will see by comparison with similar formulas for steam engine fly wheels. Great carelessness is obvious since C does not appear in formula (1), and there can be no "that is" between (1) and (2). The notation is also defective, as it does not say whether V is to be taken per stroke, per revolution or per minute, but, in fact, no one of these values will give reasonable results. Note, however, that you have taken W in pounds, whereas the notation gives it in hundred weights. As the book is from an English source the value of the hundred weight is to be taken as 112 pounds. With your error corrected the results are, however, still absurd. Several formulas are in existence in which R appears in the second power, as in this one, but there is no doubt that it should appear in the third power, as we believe it does so appear in all recent formulas.

(76) A. R. M., Cincinnati, asks: How many gears compounded and what would be their respective number of teeth necessary to move the nut of a lead screw 0.393 inch, the driving gear to make exactly one revolution and the lead screw having four threads per inch. In simple gearing the wheels would be too large as the space in which they are to work is limited. Will you kindly explain how you obtain the proper gears? A.—If the lead screw were to make one revolution the nut would be advanced the distance between two contiguous threads, which in this case is .250 inch, and as we want the nut to advance .393 inch to one revolution of the driving gear, it is of course evident that the two gears must be proportioned to each other as these two fractions are to each other; or, in other words, the gears must be in the proportion of 250 to 393. These two numbers are prime to each other; that is to say, there is no number which will divide both of them without a remainder, and, therefore, if simple gears were to be used they would have to be 250 and 393, the latter being the driver. These being too large, we wish to know what four gears may be used to compound and get the required movement. For this the compound gears must have the same compound ratio to each other, *i. e.*, the product of the drivers and the product of the driven gears must be to each other in the ratio of 250 to 393. The most convenient way of doing this is to arrange the numbers in the form of a common fraction, thus, $\frac{393}{250}$ and we then want to find two other common fractions which when multiplied together will equal this one. To do this we find a number which will divide the numerator of our fraction without a remainder, and such a number is obviously 3, and dividing we get 131. We then place for the numerators of our new fractions the numbers 3 and 131, and also dividing the denominator of the original fraction by the first number that suggests itself we get 10 for a divisor, which goes into 250 25 times.



American Machinist

We use these two numbers for the denominators of the new fraction, and we then have

$$\frac{3 \times 131}{10 \times 25}$$

which shows that if we were to use or, rather, if we could use for the two drivers, gears having 3 and 131 teeth and for the driven gears having 10 and 25 teeth we should have the desired ratio and movement of the nut. But a gear with 3 teeth is not practicable, and one with 10 is scarcely more so in practice, and we therefore multiply both terms of the fraction 3-10 by the same number, which, of course, can be done without changing its value, and in choosing this multiplier we take a number which will make the two gears represented by this fraction no larger than is necessary. We will therefore choose 4, which will give us 12 and 40 for the two gears, and our fractional factors of

$$\frac{250}{393} \text{ become } \frac{12}{41} \times \frac{131}{25}$$

and if we use 12 and 131 for drivers and 40 and 25 for driven gears we shall have the required movement. When, however, we come to arrange these gears as in the figure we find that if we increase the first

driver to 24 teeth and the first driven gear to 80 (doubling both) we shall not increase the space required, and as the ratio is the same this will probably be the best arrangement. The gears thus arranged occupy about one-quarter the space that two gears having 250 and 131 teeth would require. If, however, there is room a still better arrangement would be to double the number of teeth in the first driver and the last driven gear, making these 48 and 50 respectively. This would not change the ratio, and the space required would still be much less than with simple gearing.

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General Electric Company.

The directors of the General Electric Company, at a recent meeting, voted to recommend to the stockholders a reduction in the share capital of the company, both common and preferred, of 40 per cent., so that each holder of 100 shares of present stock will get sixty shares of the new stock. This settlement, while satisfactory to the common stockholders, is regarded as particularly favorable to the preferred shareholders, inasmuch as it will render unnecessary the taking of any steps for the liquidation of the company, in which event the preferred stockholders would receive only the same amount as the common stockholders and no back dividends. The plan now adopted contemplates the payment from the surplus earnings of the company as they are hereafter made of the accrued dividends on the preferred stock. On the basis of the new capitalization $1,275,000 will be required annually to pay 7 per cent. upon the preferred stock and 6 per cent. upon the common stock. A stockholders' meeting will be held August 10, 1898, at noon, at Schenectady.

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War Revenue from Inventors.

WASHINGTON, D. C., June 30.—The Commissioner of Patents has issued the following notice, in accordance with the provisions of the war revenue act, which will be of interest to inventors:

"Notice is hereby given that to all certificates required by law to be issued by this office there must be affixed the proper revenue stamp, to the value of 10 cents, which must be provided or paid for by the party ordering the certificate, and that mortgages of patent rights and conveyances of such rights in trust to be sold or otherwise converted into money, which shall be intended only as security, either by express stipulation or otherwise, which are offered for registration in this office, and all powers of attorney must be provided with the stamps required by this act. Unless such mortgage, conveyance or power of attorney be stamped in accordance with this act it will not be registered or entered on the records of this office, but will be returned to the party offering it for compliance with the provisions of this act." A. F. T.

Mr. Norris' Time Chart.

Mr. H. M. Norris expresses his wonder that we should accept for publication an article from him like that entitled "A Time Chart," and then discredit it by an attached foot note, and, in fact, he virtually enters his protest against it. We think his position is well taken. Moreover we think (*i. e.*, the editor of this paper thinks) that the chart shown by Mr. Norris is a good one for the purpose for which it was devised. It is a more or less bothersome problem in mental arithmetic to figure elapsed time between two given periods in the day, especially when one period is A. M. and the other P. M. and the noon interval is a fractional part of an hour. The workman generally uses the face of his watch or of the shop clock for doing this, but the chart is undoubtedly better. The comment complained of was written by another under a misapprehension, and is, hereby, so far as possible, withdrawn.

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The Thomas S. Clarkson Memorial School of Technology.

We have received circulars of the above named institution, located at Potsdam, N. Y., which has been established recently by the sisters of Mr. Clarkson.

The school offers four-year courses of study of the usual type in mechanical, electrical and civil engineering, as well as two-year courses in mechanic arts, manual training and domestic science.

We regret to see that, so far as the major courses of study are concerned, the policy of high admission requirements has been adopted. We have taken occasion to express our disapproval of this tendency in the past and need not repeat our opinions here. Some day, we predict, someone will establish an engineering school of the highest grade, with entrance requirements adapted to the acquirements of boys from the shops, and with it achieve a measure of success that will dwarf the accomplishments of the schools conducted on the present scholastic lines. For the minor courses entrance requirements are simple, but we regard such an action as a case of "throwing a tub to a whale."

The tuition requirements are $80 per annum for the major and $40 per annum for the minor courses, and living expenses are stated to be very low.

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The Society for the Promotion of Engineering Education.

The above named society will hold its fifth meeting in Room 22 of the Walker Building of the Massachusetts Institute of Technology, Boston, Mass., August 18, 19 and 20, 1898. J. B. Johnson, St. Louis, Mo., president; Albert Kingsbury, Durham, N. H., secretary.

Scotty's Address to Spain.

J. W. Bengough in "Toronto Globe."

(It is stated that the real reason of the inactivity of the Spanish fleet at Cadiz was the difficulty of replacing the Scotch engineers, who resigned their posts, refusing to fight against the Americans.—Press Dispatch.)

Oh, aye, I gar my engine shine,
An' industry wi' brains combine,
My wages—aye, they suit me fine—
The job's a' richt;
But, Maister Spain, I draw the line
At wham I fecht!

A'll stay an' dae hail-herted wark
'Gainst Roosian, Gearman, French or Turk,
An' nae stern duty wull a' shirk
To gar Spain win;
But in my breist saft feelin's lurk
For my ain kin.

'Tis true the Yankee mayna' be
A Presbyterian, lik' me,
Nor diz he speak so pearfeckly
Oor mither tongue;
But fecht w' him—I canna dee
A thing sae wrang!

There's maybe p'ints a' dinna lo'e,
An' ithers that fair gar me grue
Aboot his Government, it's true—
Things far frae guid;
But then, ye ken, there's ithers, too,
That show his bluid.

His flag is no juist like oor ain—
A' mean the Breetish, Maister Spain—
No' juist sae simple-like, an' plain,
Wi' 'ts stripes and stairs;
But wi' oor Jock, for Richts o' Men,
The breeze it shares!

Na' na' a' see the day's at han'
When Saxons maun thegither stan'
In Leeberty's maist holy ban'
'Gainst banded foe;
An' there, thegither in the van,
Thae flags maun flow!

Sae, Maister Spain, a'll need tae gang
Frae this auld lan' o' dance an' sang,
An' drop the job a've had sae lang,
A'm greatly fearin';
Y'er ain folk maun juist get the hang
O' engineerin'.

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Personal.

Mr. Chas. Churchill, of London, sailed for home on the "Lucania," leaving New York on the 2d inst.

Mr. F. A. Dennis is in charge of the New York office of Wyman & Gordon, at 116 Liberty street, New York.

Our contributor, Assistant Engineer J. E. Johnson, Jr., U. S. N., is ordered to the Norfolk Navy Yard with the "Rainbow."

Mr. W. S. Smith, who for some years has been connected with the E. W. Bliss

Company, of Brooklyn, has been placed in charge of that company's branch at Chicago, in place of C. W. Ellsworth, who recently died in Cincinnati.

Hugh L. Thompson, for four years assistant superintendent at the Waterbury-Farrel Foundry & Machine Company, Waterbury, Conn., has opened an office as consulting and contracting engineer at Citizens' Bank Building, Waterbury.

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It is stated that nickel aluminum tubing has been made 0.036 inch outside diameter, with walls 0.0015 inch thick and 3,000 feet, or over half a mile, weighing only 1 pound.

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Estimates have recently been compiled showing that during the first six months of the present year 1,092 miles of new railroad have been constructed in the United States. Alabama takes the lead with 125 miles. Three-fifths of the total mileage was built in the States west of the Mississippi.

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The President, on the 23d inst., sent to the Senate a convention signed by the United States and representatives of other nations, renewing and amending the convention relating to industrial properties. This agreement, which provides for international protection of patents and trade marks, is renewed every few years.

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Obituary.

Edwin H. Bennett, president of the Babcock & Wilcox Company and treasurer of the Singer Manufacturing Company, died in this city on June 27. Mr. Bennett was a highly successful mechanic, who had gone nearly the entire length of the ladder. He began work in the shop at the Atlantic Steam Engine Works, Brooklyn, in 1861. A few years later he was connected with the Singer Company, becoming engineer in chief in 1873 and assistant superintendent in 1883. Concurrently with the filling of these positions he also had personal supervision of the construction of the Babcock & Wilcox boiler, and his connection with the two companies finally brought him to the official positions which he filled at the time of his death. He invented numerous details in connection with the Singer sewing machine and its manufacture. He was in later years an enthusiastic yachtsman, and spent much time on the water.

Edwin Mickley, a retired machinist and engineer, died at Mickley's, Pa., June 25, sixty-eight years old. He had a common school education, and entered the service of the Crane Iron Works, Catasauqua, Pa., in 1848. Later he was employed by a New York concern and then engaged in the foundry and machine business for himself. He built the first engine used in the zinc mines at Friedensville. Later he was associated with the Thomas Iron Company as mining engineer. He resigned eight years ago, spent some time in traveling, and then became a leading farmer.

Samuel Lessig, for over thirty-five years a manufacturer of agricultural implements at Reading, Pa., died in that city June 27, seventy-five years old. His specialty was a horse rake of his own invention.

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Inquiries for Machinery.

Those who make, or may know of the makers of such machinery as is called for below, will oblige us by sending name and address, mentioning the number of the inquiry. We cannot forward catalogs. We have inquiries as follows:

56. For name and address of makers of the Victor scroll saw.

57—Machines for manufacturing excelsior.

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Commercial Review.

NEW YORK, Friday Evening, July 1, 1898.

THE ENGINE MARKET

Is as drowsy as the weather, but since business, like humanity, cannot yield entirely to its spirit of laziness, a fair number of contracts are reported, some of which we will mention in course. Rumors of higher prices have come to nothing worth mentioning, and sellers realize that this is not a propitious time to stand out for better profits.

Last year many steam road rollers were sold in this vicinity owing to the amount of municipal improvement that was going on. This year the call for them here is less urgent. One seller reports that business elsewhere is as good this year as last, though the representative of another company does not so find it.

The E. P. Allis Company seems to be impervious to the war and every other deleterious influence. Its shops are congested with work and on engines which normally could be shipped in ninety days from the receipt of the order six or seven months are now sometimes required. A 1,500 horse-power engine of this make has lately been sold to Ernest R. Behrend & Co., who are erecting a new paper mill at Erie, Pa. These parties control mills in Germany.

It is also for a paper mill, situated near Montreal, that the Abendroth & Root Manufacturing Company is executing a large contract for spiral riveted pipe. The company has taken important contracts for pipe for water works in Paris, Tex., and New Sharon, Ia., which, together with the first named, foot up now to between $60,000 and $70,000, although the entire orders have not yet been received.

The New Orleans Edison Company will install a 1,250 horse-power, 100 revolution, vertical cross compound, condensing McIntosh, Seymour & Co. engine, to be direct-connected to two 400-kilowatt generators.

A sale of thirteen boilers in one lump is reported in this market, but the parties interested wish, for various reasons, to keep the particulars private.

J. D. Miller & Co., 39 Cortlandt street, New York, who have for some time handled the goods of the Fitchburg Steam Engine Company, are now handling those also of Houston, Stanwood & Gamble, Cincinnati, and of the Chambersburg (Pa.) Engineering Company. Among the more interesting recent work of the Fitchburg Company is the erection, just completed, of a 600 horse-power direct-connected engine embodying a new valve motion and style of frame, for the Fitchburg & Leominster Street Railway Company. A steam power plant, including an engine of the same type, is being built for the Nazareth (Pa.) Cement Mills. A Fitchburg compound engine is also being constructed for the Government of Mexico, to which country several have been sent this year.

Having heard a rumor of certain changes in the affairs of the Weston Engine Company, Painted Post, N. Y., we inquired at the New York office and are informed that since the recent death of Mr. Weston his legal representatives propose to withdraw his interest and that it is intended to reorganize the company. Mr. J. B. Stansfield, Elmira, N. Y., has been made assignee, and no new contracts are at present being taken, although the shops are still running upon the execution of old orders, of which a large number were in hand not long since.

The Seamless Metal Ware Company, Sing Sing, N. Y., is installing an electrical distribution system, free of countershafting, in its plant. One, and probably another, Russell engine of 50 to 60 horse-power will be put in and a dynamo, made by the Northern Electric Company. If contemplated extensions are carried out it is said that the Seamless Metal Ware Company will probably make additions to its equipment of stamping machinery, presses, etc.

Few prizes either directly or indirectly connected with war material manufacture fall to the share of the engine manufacturers. It is reported, however, that a new experimental powder works in this part of the country will shortly install two or three engines of 200 horse power each. A certain make of engine is mentioned in the specifications, which, however, are not believed to be absolute.

MISCELLANEOUS.

The Russian Government will admit free of duty for ten years machines for

washing gold in the Siberian and Ural fields.

It is rumored that the Warsaw-Vienna Railway Company is to make arrangements for the construction of its rolling stock at its works at Warsaw. Does this signify a new locomotive plant for Americans to equip?

A company, called the Electric Power Company of Santiago de Chili, has been formed in Berlin with a capital of 24,000,000 marks, and with the object of executing extensive electric projects in Chili.

As far as may be judged from a list of cranes, electric and otherwise, sold by the Case Manufacturing Company, Columbus, Ohio, the electric ones are the more popular. The following concerns have lately bought electric cranes from it: The Reeves Iron Company, Canal Dover, Ohio; the National Electric Company, Brooklyn, N. Y., and the Bullock Electric Manufacturing Company, Cincinnati, Ohio. In a summary of those recently installed we notice two 30-ton electric traveling cranes shipped to Sydney, New South Wales.

Two 450-kilowatt General Electric dynamos have been sold for railway purposes in the City of Mexico. They will be directly connected to two 700 horse-power engines made by a prominent company in this State.

An enterprise is now on foot to introduce into Milan an electric current of 10,000 horse-power developed from the River Adda at Paderno and conveyed across country by overhead wires a distance of 20 miles. There will be seven dynamos and seven 2,160 horse-power turbines, one of them being held as a reserve. Part of the current generated will be used at Menza. From the fact that the work is controlled by a company called the "Edison Company," which operates the electric railways at Milan, we shall not be surprised if it transpires that the General Electric Company is to furnish the electrical machinery.

At the Frick Company's New York office the refrigerating machinery business is reported improving. Sales within a month included an 180-ton condensing system for the North Packing & Provision Company, Boston; a 15-ton ice plant with two 80 horse-power boilers for a party in Nyack, N. Y.; an ice and refrigerating plant for Japan, and others.

More machinery is required for Mare Island. The bids for this last addition will close July 26. It includes: Motor-driven, single plate planing machine; belt-driven, single punching or shearing machine; two radial jib countersunk drilling machines; one emery wheel floor grinder, two wet grinding stones, 18-inch screw cutting engine lathe, 48-inch vertical boring and turning machine, one tool grinding machine and emery wheel, band saw for sawing metal, brass founder's spruce cutter, improved jointing and facing machine, standard chain-saw mortiser, double spindle upright molding machine.

A report from Hamilton, Ont., is to the effect that the Cataract Power Company will shortly award contracts for a new power plant to cost $600,000. It will include about 4½ miles of pipe.

CINCINNATI REPORT.

In the early part of June was perceptible a little less demand than formerly for machinery and machine tools, but the month ended with some show of improvement. Despite the transference of public interests from business to war the former is much better now than for several years past. Some manufacturers are doing less than their neighbors and think that the war is retarding trade, but they are the exceptions rather than the rule. Generally speaking the war seems to have helped business rather than to have injured it.

One marked feature is the large demand for engines to be shipped to sugar plantations and rice mills in the South, showing that there are prospects for good crops in those lines. While home trade is fairly good and improving, exports are more active and are broadening out over new fields; for instance, the Scandinavian countries. Sugar machinery is in improved demand from Mexico, where many new plantations have been started by parties driven out of Cuba.

The I. & E. Greenwald Company has lately received orders for some ten engines of from 40 to 250 horse-power from Chicago, Detroit and Texas; also for two engines here and three there for ice making plants. There are some inquiries for elevator work.

Crawley & Johnston will supply one of their new steam steering gears for the steamer St. John, now being built here for the Mississippi Packet Company, to run in the New Orleans trade.

George C. Keene & Co. are building a 25,000-pound corrugating machine, for making steel roofing, for the Cambridge (Ohio) Rolling Mills, and one of the same size for the American Steel Roofing Company, of Cincinnati. Heavy machinery will also be sent to Memphis, Tenn., for making steel stoves and ranges, and sheet metal working machinery to Norfolk and New York.

Dreses, Mueller & Co. have remodeled their shop by putting in a new brick front and offices and drawing room on the second floor. They have added a basement space for the smith shop, a stock and wash room of 1,500 square feet and another floor of 6,000 square feet, which they have filled with new machinery. They say: "Business is exceedingly good, but the foreign orders still amount to 80 per cent., and, in our opinion, if this trade ever should stop very good channels must be opened to keep the tool man busy."

The J. A. Fay & Egan Company is to send Mr. Geo. W. Wipper, one of its skilled machinists, to Denmark, to supervise the installation of several complete outfits of wood working machinery. It is making good sales to parties in Sweden, Germany, England and France. Demand is active in the South and West of this country. Domestic business is found better than for several years and foreign is as good now as before the war broke out.

PITTSBURG REPORT.

Nothing of a special character has transpired in any line of the iron and steel market during the past month. Production of pig iron is keeping well up to the average, there being but three furnaces in the entire Pittsburg district. The consumption of iron is not quite equal to the production, as many of the foundries are not running to their full capacity. No heavy purchases by any one concern have been heard of for some time, but it is thought that after the summer season more iron will go through the markets and stocks will be reduced to a great extent. Prices for all grades of iron have not shown any material change, remaining practically as they were at last reports.

The market for different machine goods can also be said to be somewhat at a standstill. By this it is not meant that no sales of any size have been made, but no large contracts for rolling mill equipment have been awarded. Most of the work now being done is for repairs to mills that have been hard driven. This is the season for repair work, and machine shops are pretty well filled up on work of this character.

The mill supply people are in the midst of their active season, and are kept busy shipping to all points. They are better satisfied with the prices they are receiving for their goods this year than they were last. It might also be said they are doing at least 100 per cent. more business.

The National Tin Plate Company, at Monessen, Pa., expects to put its present plant in operation about August 1. The intention of the company is to add largely to the capacity, putting in more mills and making it about the largest of its kind in the country. It is not known how soon bids will be wanted for the equipment, but it will probably be in the very near future. The Monessen Foundry & Machine Company was recently chartered to operate a foundry and machine plant at Monessen. Ground is now being staked off and building operations will be begun shortly. The Phillips Mine Supply Company, of Pittsburg, has been running its plant on mine cars, wheels and steel tipples at almost full capacity for some time, and is meeting with

marked success in disposing of its self-oiling wheels.

CHICAGO ENGINE MARKET.

The work in engines and dynamos that is now being done for the electric companies is confined mainly to the large city lines. The interurban trade is not brisk. For this there is ample reason. The large electric lines now in operation have no difficulty in procuring all the money they want for extensions and improvements, but the country roads, which are much more experimental in their nature, are less favored by the powers that provide the funds for construction. When the cycle of time that marks the alternate periods of commercial depression and inflation advances a little farther in its upward course the money interests will, if history is repeated, become more complaisant, and the activities in this line of electric railroad construction from town to town promise indefinite expansion, perhaps to the point that some eager makers will accept bonds in lieu of cash for their equipment. That period has not yet arrived. It is not wholly to this expected era of electric railroad construction that trade finds its best promise. It is predicted by some people who keep in close touch with the market conditions that within a year at least one of the large Western railroads will be experimenting with electricity as the motive power for its Chicago suburban passenger traffic; but progression is not looked for here so rapidly as in the more thickly populated New England districts.

Concerning the trade in the smaller engines, one of the most frequent comments that are made is that the prices at which sales are made are the most unsatisfactory part of the business. Margins continue more slender than in the more expensive lines. Some sellers report that from the miscellaneous iron-working shops comes a very fair trade, attributed to the general "run-down" condition of power plants through a series of years now rapidly ending. Others remark, somewhat malevolently, that until an inspector punches a hole through a boiler the manufacturer will continue to use it, and that an engine is maintained equally as long. It is common talk, however, that the engine builders are almost without exception very busy, many of them working overtime.

The ginning mills in the South are now generous buyers of engines. The export trade runs on in an expanding volume. For the moment the Northwest is said to be less active in machinery buying than other sections of the country.

In the general machinery lines the bicycle trade seems to be over for the season. In plumbers' supplies there is fair activity. The stove makers are expected to do some buying in July. The ordinary trade is dull. It is rather singular that while many of the selling agencies are doing a good trade, it is in almost every instance attributed to "special business," which includes, besides machinery for special purposes, the refitting of several plants destroyed by fire and orders from unexpected sources. The ordinary channels of trade are running dry almost, waiting for the seasonable rains to gladden and refresh.

The Buckeye Engine Company is running overtime, but the bulk of the present orders are coming from abroad and from the South.

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Quotations.

NEW YORK, Tuesday, July 5.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$11 00 @ 11 50
No. 2 foundry, Northern	10 50 @ 11 00
No. 2 plain, Northern	10 00 @ 10 50
Gray forge, Northern	9 75 @ 10 00
No. 1 foundry, Southern	10 50 @ 10 75
No. 2 foundry, Southern	10 00 @ 10 25
No. 3 foundry, Southern	9 75 @ 10 00
No. 1 soft, Southern	10 50 @ 10 75
No. 2 soft, Southern	10 00 @ 10 25
Foundry Forge, Southern	9 50 @ 9 75

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.05 @ 1.10c.; refined, 1.10 @ 1.20c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.30 @ 1.50c.

Tool Steel—Base Sizes—Standard quality, 6 @ 7c., with some grades perhaps a little less; extra, grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, in small lots, 1.40 @ 1.45c.

Cold Rolled Steel Shafting—Base sizes, from store, 2.05 @ 2.10c., according to quantity.

Copper—Carload lots: Lake Superior ingot, 11¾c.; electrolytic, 11½c.; casting copper, 11⅜c.

Pig Lead—Carload lots, 3.95 @ 4.00c., f. o. b., New York.

Pig Tin—For 5 and 10 ton lots, about 15⅞c., f. o. b.

Spelter—Carload lots, 4.90 @ 5.00c., New York delivery, for ordinary brands.

Antimony—In cask lots: Cookson's, 9½ @ 9¾c.; Hallett's, United States, Japanese, 8¾ @ 9c.; French E. B., 9c.

Lard Oil—Prime city, ice pressed, 50 @ 52c., wholesale.

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Manufacturers.

The old Hope Mill of the Pottstown (Pa.) Iron Company's plant is being remodeled.

Richard Stock and Samuel Mathews, of Akron, Ohio, will begin the erection of a machine shop.

Enterprise Foundry & Machine Works, Rock Hill, S. C., contemplates putting in new machinery.

The Walker Company, Cleveland, Ohio, is making a number of additions and alterations to its plant.

The Standard Manufacturing Company, of Winsted, Conn., has decided to build a factory 150x25 feet.

At Paterson, N. J., James Simpson & Co. will erect an additional building, 85x157 feet, to their present plant.

The Illinois Central Railroad has just given an order for $350,000 worth of new motive power and rolling stock.

The Folding Coop Company, S. P. King secretary, Charlotte, N. C., will place new woodworking machinery.

The C. H. Dutton Boiler Company, Kalamazoo, Mich., is putting up a new foundry, 60x120 feet, two stories high.

The A. H. Stange Company, Merrill, Wis., is making additions to its plant. These additions consist of a planing mill 96x66 feet and a power house 90x30 feet.

The Wetherill Separating Company has been incorporated at Trenton, N. J., to engage in the manufacture of concentrating machinery. Jacob Longeloth, J. P. Wetherill, John H. Judson, of New York, and Edward Balbach, Jr., of Newark, are the incorporators.

The Kemp Manufacturing Company, of Toronto, Ont., has found it necessary to enlarge its factory, and it is probable that in the near future an addition will be made.

The Jamieson-Combe Iron Company, St. Joseph, Mo., has purchased the vacant lot on Francis street, between Main and Second, and will erect a machine shop 50x80 feet.

We wish to correct a statement in a recent issue to the effect that the Hansell Spring Company, of Newark, N. J., would move its plant to Ambler, N. J. This should have read Ambler, Pa.

Articles of incorporation of the Philadelphia Graphite Company have been filed at Camden, N. J. William Faux, E. N. James, Ed. Inkseep and Francis C. Husbands are among the incorporators.

The Diamond Drill & Machine Company has commenced the construction of a new building at the Birdsboro (Pa.) Works. This building will be 80x30 feet, in which new machinery will be installed.

A large brick building is being added to the H. N. Strait Manufacturing Company's plant, Kansas City, Mo., which will, when completed, increase the present facilities of production by about 50 per cent.

The Le Berthon Company, of Trenton, N. J., was recently incorporated to manufacture machinery. George W. Wallace, Theo. T. Le Berthon, C. C. Hodgeman, of New York, and K. W. Barry, of Bayonne, N. J., are interested.

The Otto Higel Company, Limited, manufacturers of pianoforte actions, cases and specialties, whose factory is at present situated at 91 and 93 Richmond street, Toronto, Ont., have applied for concessions in view of the fact that they desire to enlarge their premises and increase their staff. For this purpose they have

Business Specials.

Gear wheels, gear cutting. Grant; see page 20.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Conn.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Cutters, reamers and small tools, regular and special; vertical millers, cutter and surface grinders, shears and punches. R. M. Clough, Tolland, Conn.

Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Machine blacksmith desires a change; experience 12 years; age 29; A1 workman. Box 124, AM. MACH.

A technical graduate desires an opening with chance for advancement, twenty-five years old; rapid draftsman; New England preferred. Box 127, AM. MACH.

Designing, tool making, fine mechanical work and superintendence of work; twenty years' experience and up to date. Box 125, AMERICAN MACHINIST.

Wanted—Position by young man (28), who is a machinist, draftsman and technical graduate; willing to invest some money. Box 122, AMERICAN MACHINIST.

First-class machinist, with four years' experience, desires position in Boston, in store or shop where machine tools are sold or made. Address Box 114, AMERICAN MACHINIST.

Position by A1 tool maker; expert on fine accurate work, experimental and automatic machinery; have had charge; best references; twelve years with last employer. Box 126, AMERICAN MACHINIST.

Shop supt. with a practical engineering and business experience is open to a change; can design, make sales, or handle office; age 38; exceptional references. Address Box 128, care of AMERICAN MACHINIST.

Help Wanted.

Wanted—Good machinists for night force on tools. Address Ball and Wood Co., Elizabethport, N. J.

Wanted—First-class assistant layer-out for a large boiler shop. Address, giving wages desired and experience, Struthers, Wells & Co., Warren, Pa.

purchased a lot, upon which they intend to erect a factory. The factory will be three stories high, 110 feet long and 40 feet wide.

The Gibboney Radiator Company, of Indianapolis, Ind., has been incorporated by H. M. Gilchrist, L. C. and G. W. Gibboney.

It is believed that the firm of Shickle, Harrison & Howard, of St. Louis, Mo., will erect a manufacturing plant at Winstanley Park.

The Clinton Worsted Company, of Clinton, Mass., is arranging to make extensive improvements and enlargements to the factory.

Gallant Brothers, of Paterson, N. J., are reported to have completed arrangements for the erection of a cotton mill.

The Indiana Sugar Manufacturing Company, of Hartford City, Ind., has been incorporated by W. N. Cronin, D. H. Fouts, T. W. Sharpe and D. J. Hummer.

Fort Pitt Bronze Company, of Allegheny, Pa., has been incorporated, capital $50,000, to manufacture iron. Incorporators—William J. James, H. L. Thumm, William J. McKee and G. W. Williams, Pittsburg, and Charles V. McLaughlin, Allegheny.

Phillips & McLaren have been granted a permit for the erection of a frame and iron-clad structure to be used as a machine works, foundry and pattern shop. The building is to be located at Twenty-fourth and Smallman streets, Philadelphia, Pa.

The Witte Iron Works, Kansas City, Mo., sends us catalog of gas and gasoline engines for pumping, hoisting, electric lighting and marine service. The cover is neatly printed, and has the Cuban and American flags crossed. The catalog is 4½x7¼.

The Lacy Manufacturing Company, of Los Angeles, Cal., was recently incorporated with a capital stock of $100,000. The company is to engage in the manufacture of iron and steel water pipe, oil tanks, etc. William Lacy, J. E. Lacy and Richard H. Lacy are interested.

The American Emery Wheel Works Company is about to erect a new building for carrying on its manufacturing business. The factory will be erected on the corner of Waterman and East River streets, Providence, R. I., and will be 99x45 feet, two stories in hight and will be built of brick.

The International Heater Company, of Utica, N. Y., capitalized at $1,800,000, has been incorporated. The company proposes to manufacture all kinds of heating apparatus, and its directors are Frank E. Wheeler, Edward A. Carton, Francis Kernan and George L. Bradford, of Utica; Ephraim K. West, Elisha M. Moore and Hendrick S. Holden, of Syracuse.

The Cutler-Hammer Manufacturing Company, of Chicago, and the American Rheostat Company, of Milwaukee, have consolidated. The business will be carried on under the name of the Cutler-Hammer Manufacturing Company, Chicago, Ill. The capital stock has been increased, much of which has been invested in new machinery. The officers of the new company are as follows: President, F. R. Bacon; vice-president, F. L. Pierce; secretary, J. G. Hickcox; general manager, H. H. Cutler.

The United Gas & Improvement Company, of Philadelphia, Pa., is making extensive additions to its gas producing plants. These plants are known as the Twenty-fifth Ward and Point Breeze locations. At the Twenty-fifth Ward Gas Works they are building a new scrubber house 45 feet wide and 120 feet long; a purifier house 86 feet wide and 180 feet long. At the Point Breeze Works they are erecting a new boiler and engine room 220 feet long and 55 feet wide; a condenser building 40 feet wide and 105 feet long; a purifier building 86 feet wide and 180 feet long; a generator house 100 feet wide and 184 feet long; a meter house with additions for exhaust and valve room, having a width of 70 feet and a total length of 223 feet. All the structural steel work for this plant is being furnished and

Help Wanted—Continued.

Wanted—Salesmen who call on manufacturers to sell two patented popular vises in connection with other lines they handle; liberal commission to right parties. Address P. O. Box 2347, New York City.

Mechanical draftsman to assist in designing automatic machinery and to make construction drawings; state experience and wages expected. John Adt & Son, F. B. Shuster, proprietor, New Haven, Conn.

Foreman for machine shop, employing twenty men on job and special work; one who can successfully manage men; state age, wages expected and give references. Address Box 130, AMERICAN MACHINIST.

Chuck Manufacturer—Wanted first-class machinist used to latest methods in above; state fully what experience in this line and in what shops, age and salary expected; replies treated in confidence. Box 129, care of AMERICAN MACHINIST

Wanted—A large Chicago manufacturer wants a first-class machine shop foreman; one who understands handling men and modern machine shop practice; must be a hustler; no other need apply. Address Box 123, AMERICAN MACHINIST.

Wanted—A mechanical draftsman, to work on Staten Island; hours 8 to 12, 1 to 5, Saturdays 4; experienced man, thoroughly familiar with shop practice, able to figure strains, design machines, tools, etc.. none but experienced men need apply; would prefer personal interview. C. W. Hunt Co., West New Brighton, Staten Island, N. Y.

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Best Calipers, Levels, etc. E. G. Smith, Columbia, Pa

Book, Dies & Die Making, $1. J. L. Lucas, Prov., R. I.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes and planers. Dietz, Schumacher & Boye, Cincinnati, O.

Die makers, special mach'y and spec'lt'es wanted for manufacture. Bown Mach Works, Battle Creek, Mich.

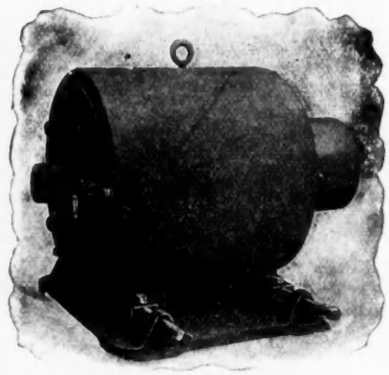
Wanted—Second-hand pipe threading machine, 1 to 3 inches. State make. Address O 26, care of Lord & Thomas, Chicago.

For Sale—One Merriman bolt cutter, 3-8 in. to 1 1-2 in.; one 1-2 in. to 2 in.—new. The McLagon Foundry Co., New Haven, Conn.

The advertising department of the American Machinist has on hand 20,000 draftsm'n's thumb tacks; will send a box of ten to any draftsman in America on request; could use a postage stamp on box, but will send the tacks anyway.

Institutions retiring from business having machine tools, brass or wood working machinery, will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach Co., 55-59 Woodbridge st., W., Detroit, Mich.

A firm of engineers and tool merchants in England, doing a large business in American machine tools, is desirous of opening up communications with tool manufacturers in America, and will be pleased to receive their catalogues. Address Tool Co., care of the Cassier Magazine Co., 3 West 29th St., New York.



The C & C Slow Speed Closed Ironclad Motor

is especially designed for hard service in mills and factories. Can be placed in any position and belted, direct connected or back-geared to its work.

Highly Efficient and Non-Sparking.

Complete Electric Power Transmission Systems.

The C & C Electric Company,

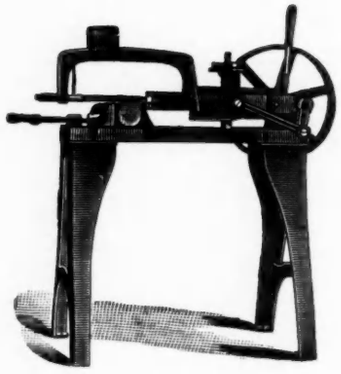
143 Liberty Street, New York.

"The best is as good as any."

The New

Automatic and Gravity Feed

Q & C Shop Saw



Cuts { Tool Steel, Machinery Steel, Iron, Brass and All Other Metals.

Price—'Way Down.

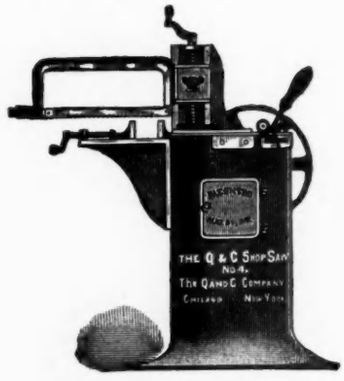
Quality—'Way Up.

Shop Saws,

Portable Rail Saws,

Cold Power Saws,

For All Purposes.



Send for Catalogue.

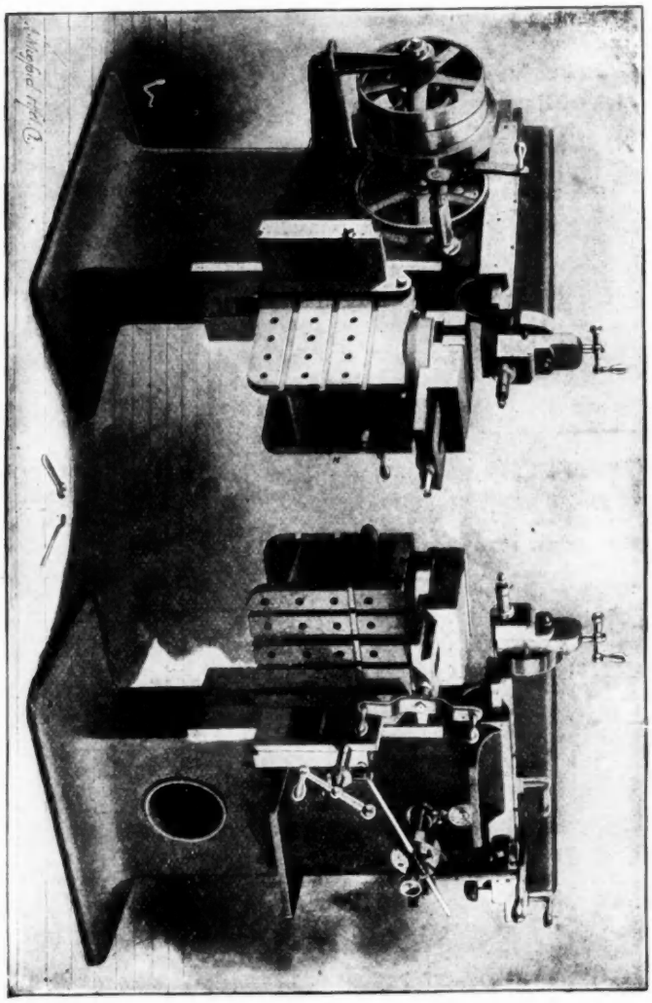
Q & C Company,

Chicago. New York.

LONDON: Chas. Churchill & Co.
PARIS: Hounsfield & Fils.
BERLIN: Schuchardt & Schutte.
MADRID: J. G. Neville & Co.

15-inch Pillar Shaper.

A FRICTION driven machine, fitted with a positive locking device for friction, insuring a uniform length of stroke under a heavy cut. Stroke can be changed to any position with ram in motion; has quick return; and our micrometer adjustment makes possible the most minute variation in length of stroke, which can be constantly varied with machine in motion; an especially valuable feature in tool and die work and in planing to irregular lines.



THE HENDEY MACHINE CO.,

Torrington, Conn.

AGENTS FOR THE PACIFIC COAST:
PACIFIC TOOL AND SUPPLY CO., . . . San Francisco, Cal.
J. W. CREGAR, ... Philadelphia Bourse Exhibition.

EUROPEAN AGENTS:
SCHUCHARDT & SCHUTTE, Berlin, Vienna, Brussels, Stockholm.
CHAS. CHURCHILL & CO., Ltd., London and Birmingham, England.
ADOLPHE JANSSENS, ... Paris, France.

erected by the Berlin Iron Bridge Company, of East Berlin, Conn.

A. L. Sayles & Sons, of Pascoag, R. I., are building an addition to their boiler house.

The Sterlingworth Supply Company, of Easton, Pa., is about to erect an addition to its plant.

Murtagh & McCarthy will erect on Rivington street, this city, an eight story factory building.

Spencer & Barnes, of Benton Harbor, Mich., are to erect an addition to their factory, 66x150 feet.

The machine shop of Burley & Galligan, at Rat Portage, Ont., was recently destroyed by fire.

The National Biscuit Company, of St. Joseph, Mo., is about to make extensive additions to the plant.

Henry Deibert & Son are rebuilding the machine shop at Elkton, Md., recently destroyed by fire.

George W. Dustan, of the Keystone Milling Company, will erect a new mill at Buffalo Center, Ia.

Plans have been prepared for an addition to the American Steel Casting Company's plant at Chester, Pa.

The Paxton Rolling Mill at Harrisburg, Pa., was recently burned to the ground, entailing a loss of $40,000.

George F. Case, of Detroit, Mich., has decided to rebuild his plant, which was recently destroyed by fire.

It is reported that the Gardner Rolling Mill, at Hastings, Minn., will be enlarged and new machinery added.

H. E. Funk has removed to Huntington, Pa., where he will operate a mill, in which new machinery will be installed.

The Keystone Steel Company, of Reading, Pa., has leased the old galvanizing works, and will manufacture steel for projectiles.

The granite manufacturing plant of Mackie, Hussy & Co., Barre, Vt., was recently destroyed by fire. The loss is estimated at $60,000.

The Ingersoll-Sergeant Drill Company, Easton, Pa., is to erect two additions, one 100x300 feet, to be used as a storehouse, and the othr 80x200 feet, to be used for foundry purposes.

The Gilbee Manufacturing Company, of Philadelphia, Pa., has been incorporated by M. A. T. Gilbee, C. P. Padmore, A. J. Wilkinson, of Philadelphia, and W. L. Block, of Hammondton, N. J. Capital, $50,000.

▲ ▲ ▲

New Catalogs.

There are three sizes of Standard Catalogs, first authorized by the Master Car Builders' Association, 9" x 12", 6" x 9" and 3½" x 6". We recommend the 6" x 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

P. H. & F. M. Roots Company, New York, have sent us catalog of blowers. These blowers may be driven direct either by engines or electric motors. The catalog is 7½x10 inches.

The Waterbury Farrel Foundry & Machine Company, Waterbury, Conn., sends us catalog M of power presses, broaching presses for broaching holes in forgings or castings and various other styles of presses. The catalog is 5½x7¼.

Harrison Brothers & Co., Incorporated, of Philadelphia, send us copy of catalog and price list of paints, colors, varnishes, etc. Accompanying this catalog is a pamphlet entitled "The Chemistry of Paints," in which an interesting account of the works is given, supplemented by practical observations on the proper use of paint, selection of colors, amount of paint re-

quired under given conditions, etc. The catalog is standard size, 6x9 inches.

We have received from the S. Obermayer Company, Chicago, general catalog of foundry supplies and equipments. The catalog contains 113 pages, and almost every accessory used in foundry work is described. The catalog is standard size, 6x9 inches.

The B. F. Sturtevant Company, of Boston, has sent us copy of catalog No. 103, which contains descriptions and illustrations of horizontal and vertical engines suitable for electric light plants. The catalog is 6½x9 inches and will be sent to anyone interested upon application.

The Ball Bearing Company, of Boston, has issued its 1898 catalog of ball and roller bearings for use in factories, bicycles, motocycles, etc. A number of testimonial letters, together with names of those using the bearings, are included. The catalog is 4½x7 inches.

We have received from the Ridgely & Johnson Tool Company, Springfield, Ill., catalog of various pneumatic tools, including hammers, riveters, calking tools, etc. Illustrations are given showing the tools in use by workmen on bridge and ship work. The catalog is 5¼x7 inches.

We have received from Fairbanks, Morse & Co., Cleveland, Ohio, two catalogs, one devoted to gas and gasoline engines and the other to gas and gasoline engines constructed specially for driving hoisting drums and air compressors and for use in mining operations. Both catalogs are 6¾x9 inches.

The Thomson Electric Welding Company, Lynn, Mass., has issued a catalog devoted to a description of the Thomson process of electric welding. The information this catalog contains is of great interest, and comparisons between this and the usual system of welding are made. The catalog is 7x8½ inches.

The C. W. Hunt Company, West New Brighton, N. Y., has sent us two catalogs, one devoted to the description of the Hunt cable railways and the other to automatic railways. Both catalogs are profusely illustrated by views of plants where these forms of railway are used. The catalogs are 7x9¼ inches.

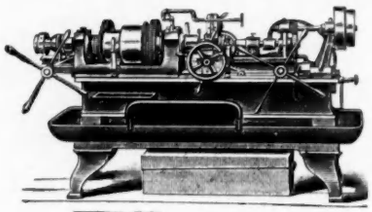
The Draper Machine Tool Company, of Worcester, Mass., are out with a new standard size catalog fully illustrating and describing their full line of lathes, screw machines and horizontal boring mills, and showing all new designs and improvements. A copy of the catalog will be sent to those interested on application.

The Chicago Belting Company, Chicago, Ill., has sent catalog of leather belting and mill supplies. The catalog contains views of the factory and also some useful information on belt lacing and other facts likely to be of value to those who have charge of belting. The catalog is 3¼x7 inches and will be sent to those interested upon application.

The Spencer Automatic Screw Machine Company, of Hartford, Conn., has sent us a copy of their recently issued catalog, in which is illustrated and described the Spencer automatic screw machine and other automatic machinery used in the manufacture of all kinds of machine screws and turned metal parts. Very complete details are given of the machine, together with illustrations of pieces of work produced by it. The catalog is bound in cloth and is standard size, 6x9 inches.

We have received from the Fitchburg Machine Works, Fitchburg, Mass., copy of catalog illustrating and describing lathes, shapers, radial drills and various other machines used in the working of metal. In addition to descriptive matter pertaining to the various tools, a considerable amount of useful information is included, together with a number of pages of cross section paper suitable for sketching purposes. The catalog contains about 130 3½x6 inch pages, and is bound in cloth.

Bicycle : Hub : Forming : and : Drilling : Machine.



The two operations are performed simultaneously as rapidly as is practicable; but a second operation is required to finish the end of the hub held in the chuck during first operation, and this work is quickly and accurately done on another turret head machine.

For a full description of the above and other bicycle part making and assembling machinery ask for the "Machinist's Catalogue."

The Pratt & Whitney Company,
HARTFORD, CONN., U. S. A.

NEW YORK: 123 Liberty Street. BOSTON: 144 Pearl Street. CHICAGO: 42 South Clinton Street. LONDON, ENG.: Buck & Hickman, 280 Whitechapel Road. PARIS, FRANCE: Fenwick Freres & Co., 21 Rue Martel.

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IN VARIOUS LENGTHS—9 to 15 in. SWING.
Latest and Most Approved Designs. Workmanship, Material and Finish of the Highest Order.

SEBASTIAN LATHE COMPANY,
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Agents: SELIG, SONNENTHAL & Co., London, Eng.; JOHN TRAGARDH & Co., Göteborg, Sweden; E. SONNENTHAL, Jr., Berlin, Germany; R. S. STOKVIS & ZONEN, Rotterdam, Holland.

PRESS-WORKING OF METALS. A treatise upon the principles and practice of shaping metals in dies by the action of presses, together with a description of the construction of such implements in their various forms, and of the materials worked in them. By OBERLIN SMITH. *Illustrated with 433 Engravings.* 276 pages. 8vo. Cloth, $3.00. *Titles of Chapters:* Introductory; Press Classification and Anatomy; A "Museum" of Presses; Dies; Materials and Measurements; Cutting Processes; Bending Processes; Curling and Seaming Processes; Drawing Processes; Redrawing Processes; Coining Processes; Press Feeding; Miscellaneous.

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"LIGHTNING" ADJUSTABLE DIES

AND MACHINE RELIEVED TAPS.
Send for Catalogue.

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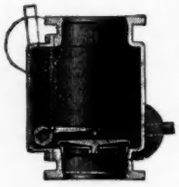

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This valve has no dash pots, springs, guides or complicated levers to get out of order. It is simple, reliable and well made. Never sticks, and can be relied upon at all times when using exhaust steam for heating; or when used as a relief, or free exhaust on a condensing plant, it has no equal. It is noiseless and free from any complicated attachments.

JENKINS BROTHERS, New York, Boston, Philadelphia, Chicago.

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CINCINNATI, OHIO, U. S. A.

"MONARCH" RIVETLESS LEATHER BELTING.
Write for Catalog "A."

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BUCK BROS. CAST STEEL

Chisels, Gouges, Turning Tools, Carving Tools, Pattern Makers' Gouges. *Send for Price List.*

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A MARVELOUS MACHINE!

Watch the wonderful work done by our **Apex Nipple and Pipe Mill Machine.** Threads nipples of all sizes. So swiveled that it can be reversed and pipe cut off close to grippers. Vise can be opened or closed while machine is in motion. *Send for catalogue.*

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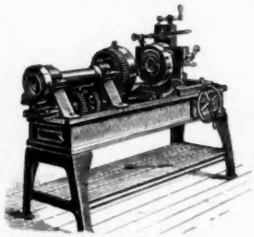

with adjustable expanding Dies.
Simplest Die Mechanism Known.
Also Pipe Vises and Steel Screw Punches.
Catalogue upon application.

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If the expenditure of a two-cent stamp on a letter to us, asking for details of our Grinding Machinery—the dividend-earning kind—brings to you information from which, if acted upon, you buy grinding machines that will handle a great deal more work in a shorter time than you are doing it now, why ain't it worth the trouble?

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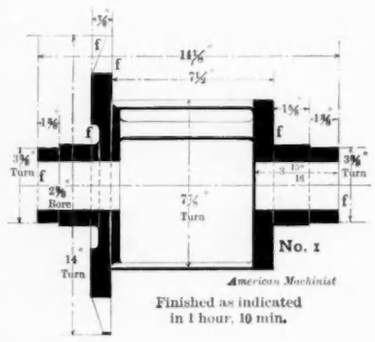

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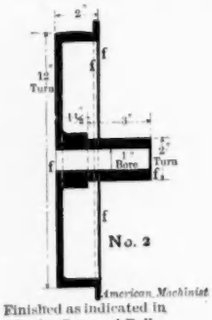
Gisholt Lathes

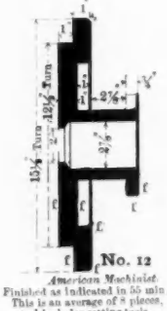
are dividend winners on duplicate work having to be bored, faced, turned or threaded. Here are three small samples, showing the time it took to produce them on a Gisholt Lathe. Just compare this time with the time it would take on an ordinary lathe. You cannot afford to put duplicate work on an ordinary lathe. It will take too long, in the first place, and the work will not be as accurate as it should be. We should be pleased to take up the matter with you at any time—preferably soon—and acquaint you with all particulars.

Gisholt Machine Co., Madison, Wis., U. S. A.

Eastern Branch, 126 Liberty St., New York; Walter H. Foster, Manager.
U. Baird Machinery Co., Pittsburg, Pa.
C. W. Burton, Griffiths & Co., 1, 2, 3 and 4 Ludgate Square, London, E. C., England.
Fenwick Freres, 21 Rue Martel, Paris, France.
Schuchardt & Schütte, Spandauer-Strasse, 59-61, Berlin, C., Germany.
Schuchardt & Schütte, Breitegasse, 17, Vienna, VII., Austria.



Finished as indicated in 42 min. Crowned Pulley



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Fay & Scott Pattern Makers' Lathes have been made and sold for a great many years, have given universal satisfaction, and no one is making a mistake when they buy them. We would be pleased to furnish the names of users of these lathes and let you do the investigating. After you have looked the matter up, we shall be pleased to afford you prices and such other data as you may desire. We'd like to send some reading matter.

Fay & Scott, Dexter, Me., U. S. A.

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are all right. Card's reputation on these tools is a result of hard, honest endeavor to produce tools a little better than anyone else. There is a "Brown Book," illustrating and describing these tools, and it's free.

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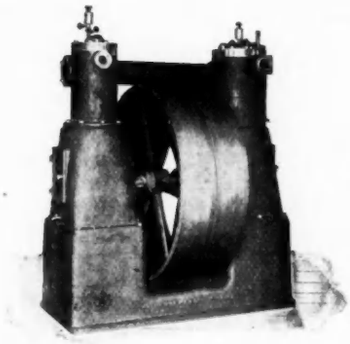
Baxter D. Whitney,

Winchendon, Mass.



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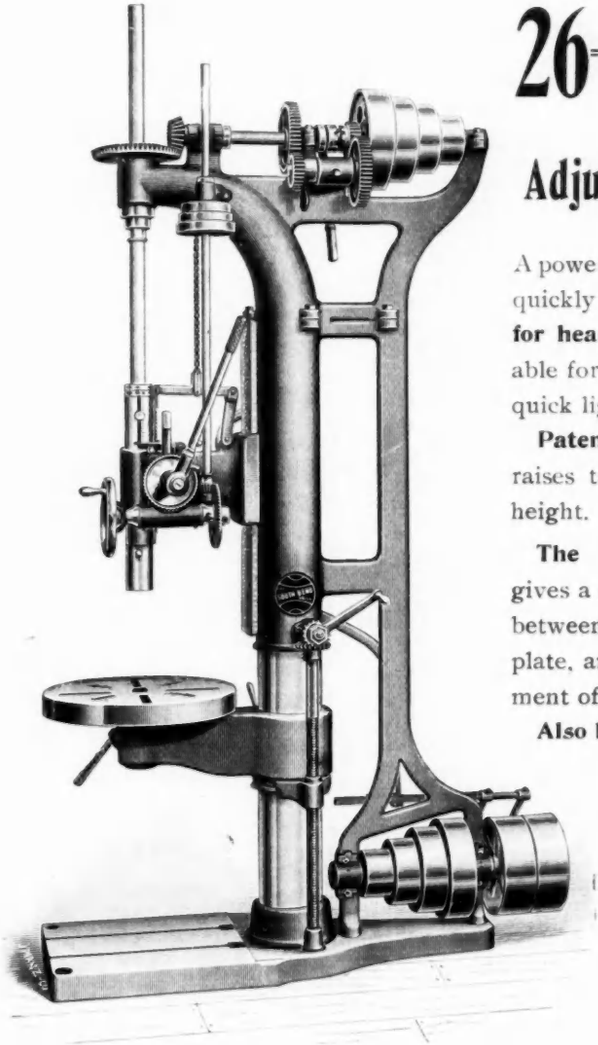

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A powerful, nicely balanced, quickly adjusted machine **for heavy work;** also available for countersinking and quick light drilling.

Patented Screw Device raises table to any desired height.

The Adjustable Head gives a capacity of 54 inches between spindle and base plate, and a vertical adjustment of 26 inches.

Also built in 24-inch.

Made with or without back gears, self-feed, reverse motion, or automatic stop, as desired.

Write for Drill Book "C."

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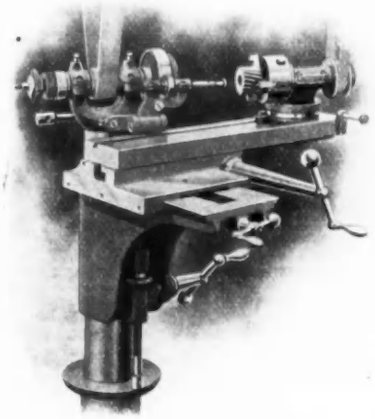
New York Agents for Export: MARKT & CO., Ltd., 193 West St.

Internal Grinding. We get plenty of Speed.



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UNIVERSAL GRINDER.

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FRICTION DISK DRILL

FOR LIGHT WORK.

HAS these great advantages: The speed can be instantly reversed or changed from 0 to 1,600 without stopping or shifting belts.

Power applied can be graduated to drive with equal safety the smallest or largest drills within its range—a wonderful economy in time and great saving in drill breakage.

Send for Catalogue.

BICYCLE MANUFACTURERS USE THIS DRILL WITH EXCELLENT RESULTS.

With the countershaft at the base, all possibility of a shaking spindle is obviated. Capacity, 0 to 5-16 in. drill. Considering cost, this is the handiest tool that can be placed in a machine shop.

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Rockford, Ill.

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Chas. Churchill & Co.,
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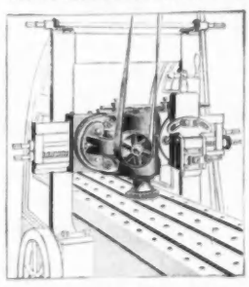

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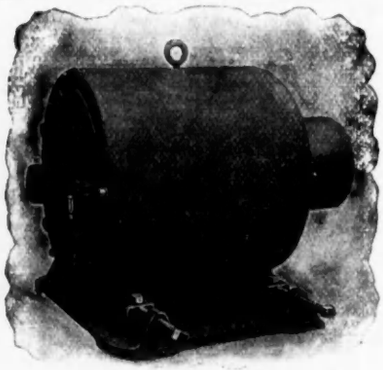

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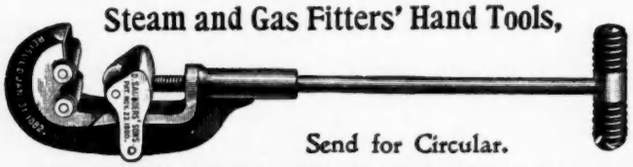

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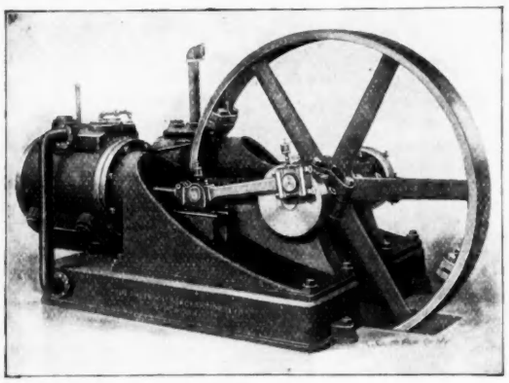

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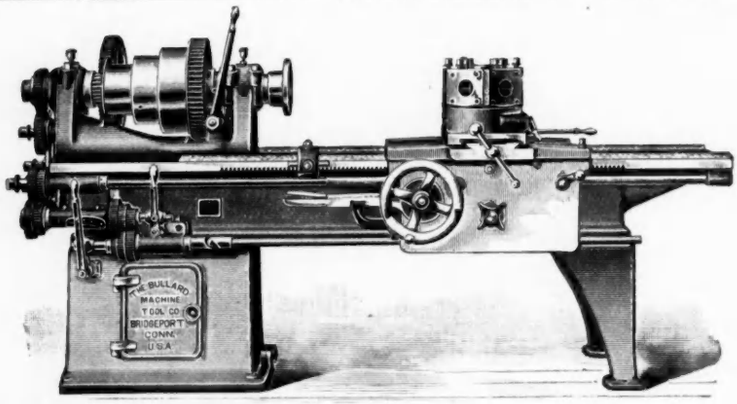

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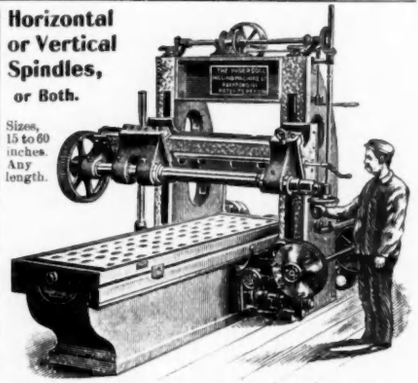

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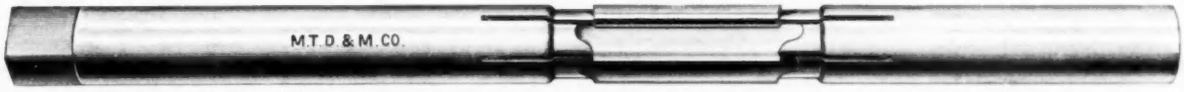

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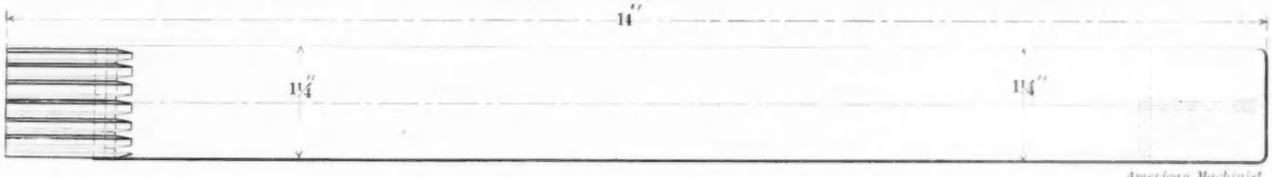

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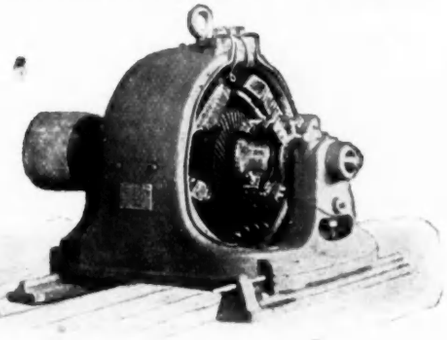

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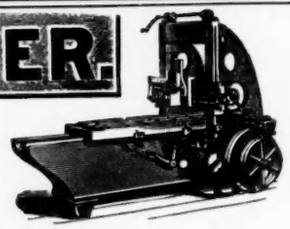

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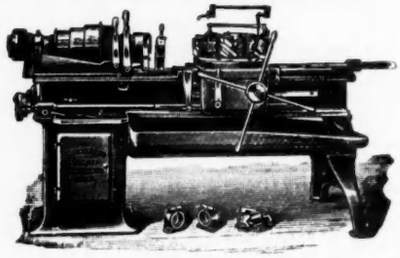

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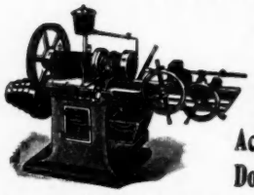

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